PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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Principal Contents

OCTOBER 1949

		PAGE
51	MATHEMATICS	631
52	ASTRONOMY. ASTROPHYSICS. GEODESY	633
53	PHYSICS	636
530.1	Fundamentals	637
531	General mechanics. Mechanics of solids	640
531.7	Mechanical measurements	640
532	Mechanics of fluids	640
532.6	Capillarity	641
532.7	Molecular theory of liquids	642
533	Mechanics of gases	642
533.7	Molecular theory of gases	643
534	Vibrations. Acoustics	644
535	Optics. Radiation. Spectra	646
536	Heat	653
536.7/.8	Thermodynamics	656
537.1	Electricity. Theory. Electrons	656
537.2	Electrostatics. Dielectrics	657
537.3	Electric conduction. Currents	658
537.52	Electric discharges	660
537.531	X-rays	662
537.533/.534	Cathode rays. Positive rays	662
537.54	Discharge tubes. Counters	665
537.56/.58	Ionization. Thermionics	667
537.591	Cosmic rays	668
538	Magnetism	675
538.3/.5	Electromagnetism. Electrodynamics	677
538.6	Magnetic effects	67
539.11	Theory of solid state	67
539.13	Molecular structure	68
539.15	Atomic structure. Isotopes	68
539.16	Radioactivity. α-, β and γ-rays	68
539.17	Nuclear reactions	68
539.18	Atom and molecule beams. Mesons. Neutrons	68
539.2	Structure of solids	68
539.3/.8	Elasticity. Strength. Rheology	69
541	PHYSICAL CHEMISTRY	69
541.124/.128	Reaction kinetics	69
541.13	Electrochemistry	69
541.14	Photochemistry	69
541.18/.182	Colloids. Disperse systems	69
541.183	Adsorption	69
541.4/.6	Chemical structure	69
542.1/.7	Chemical apparatus	70
543/545	Chemical analysis	70
548	CRYSTALLOGRAPHY	70
548.7	Molecular and X-ray crystallography	70
55	GEOPHYSICS	70
551.5	Atmosphere. Meteorology	70
57/59	BIOLOGY	70
61	Medical science. Human physiology	70
666	Glass. Ceramics	70
669	Metallurgy	70
77	PHOTOGRAPHY	70

RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACT

Mechanical testing
Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

MATHEMATICS 51

512

84. On surface-fitting in three variables. MORDU-HOW, M. *J. Appl. Phys.*, **20**, 390–2 (*April*, 1949).—simple systematic method is presented of obtaining formula of the form $z = f(x, y)$ from an experimental curve in which y is kept constant and a second perimental curve in which x is kept constant. uestions of the sufficiency of the original data are tomatically answered by this method. Several amples are given to illustrate the procedure plicitly. A.

512.3

185. New methods for the numerical solution of gebraic equations. PORTER, A. AND MACK, C. *hil. Mag.*, **40**, 578–85 (*May*, 1949).—Three methods, , B, C, are given. In A and B quadratic factors of x), where $f(x) = 0$ is the equation to be solved, are ound by trial and error. In C, $f(x)$ is divided by an bitrary factor $x^2 + ax + b$, so obtaining a remainder $xF(a, b) + G(a, b)$. A process is described r finding points on the curves $F(a, b) = 0$, $G(a, b) =$, and the points of intersection of these curves gives alue of a and b such that $x^2 + ax + b$ is a factor of x). The methods are illustrated by the numerical olution of some quartic and sextic equations. A omogram for quartics is described. L. S. G.

517.512.4 : 621.396.611.4

186. Table of roots for natural frequencies in o-axial type cavities. DWIGHT, H. B. *J. Math. Phys.*, **7**, 84–9 (*April*, 1948).—The roots of the equations,

$$J_n(x)N_n(kx) - J_n(kx)N_n(x) = 0$$
$$J'_n(x)N'_n(kx) - J'_n(kx)N'_n(x) = 0$$

re tabulated for a set of values of k ranging from ·0 to 50. L. S. G. (R)

517.564.2 : 537.226.1 : 621.3.011.5

187. Diagram of the function $z^{-1}\tanh z$ for the tudy of the u.h.f. behaviour of dielectrics. BENOIT, J. *tnn. Télécommun.*, **4**, 27–32 (*Jan.*, 1949) *In French.*—he function $z^{-1}\tanh z$ of a complex number $= u + j2\pi w$ appears in measurements of the mpedance of a dielectric slab inserted at the end of short-circuited line. A chart is developed enabling he parameters u and w to be derived from the neasured impedance, simple relations then permit the onstants ε' and ε'' of the dielectric to be deduced. A.

517.63

188. On vector transforms. MILES, J. W. Letter n *Phys. Rev.*, **74**, 1531 (*Nov.* 15, 1948).—In diffraction roblems in cylindrical co-ordinates a solution to the ector wave equation in these co-ordinates is sought. A vector transform is set up, and in terms of this the olution is written down (in integral form). Explicit esults are given for Cartesian and polar co-ordinates. L. S. G.

517.864

189. Solution of systems of transcendental equaions. LAHAYE, E. *Bull. Acad. Roy. Belg. Cl. Sci.*, 4 (*No.* 11) 809–27 (1948) *In French.*—Mathematical technique for expressing the solution in terms of simple transcendental functions. Examples studied are: (1) $e^x + 2y\sin(x/y) = 0$, $e^y - 3x\sin(y/x) = 0$, (2) $e^{24x}(x - 0{\cdot}17\rho)^2/(x + 0{\cdot}17\rho)^2 = 0$, $e^{16y} = (y - 0{\cdot}1\rho)^2/(y + 0{\cdot}1\rho)^2 = 0$, $e^{12z} - (z - 0{\cdot}1\rho)^2/(z + 0{\cdot}1\rho)^2 = 0$, where $\rho^2 = x^2 + y^2 + z^2$. The set (2) occurs in a problem of vibrations. L. S. G.

517.9 : 530.145

5190. Sommerfeld's polynomial method in the quantum theory. RUBINOWICZ, A. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 4) 351–62 (1949) *In English.*—The method is one for treating a number of important eigen-value problems. The scope of the method is discussed, and application is made to (1) the radial wave functions in the spherically symmetric case, (2) the differential equation of the associated Legendre functions and the Jacobi polynomials. L. S. G.

518.2

5191. Tables of the confluent hypergeometric function $F(n/2, \frac{1}{2}; x)$ and related functions. *Nat. Bur. Stand.* [*U.S. Dept. of Commerce*] *Appl. Math. Ser. No.* 3.—The functions tabulated are important in statistics, especially in analysis-of-variance tests. They are (1) $F(\frac{1}{2}n, \frac{1}{2}; x)$ for $x = 0(0{\cdot}01)0{\cdot}10$; $n = 3(2)201$, (2) $F(\frac{1}{2}n, \frac{1}{2}; x)/\cosh\sqrt{\{(2n-1)x\}}$ for $x = 0(0{\cdot}01)0{\cdot}10$; $n = 43(2)201$, (3) $\log_e F(\frac{1}{2}n, \frac{1}{2}; x)/\sqrt{\{2nx\}}$ for x ranging from 0·10 to 100 and n from 3 to 201. L. S. G.

518.2

5192. Numerical tables of Tchebychef's q-functions and their integrated and derived functions. OKAYA, T. *Proc. Phys.-Math. Soc. Japan*, **23**, 788–98 (1941).

518.3

5193. A nomogram for $F_0^x = \frac{1}{2}\frac{2}{\sqrt{\pi}}\int_{t=0}^{t=\frac{x}{m\sqrt{2}}} e^{-t^2}dt$

HAASBROEK, N. D. *Bull. Géod.* (*No.* 10) 285–8 (*Oct.*, 1948) *In English.*

518.5

5194. The mechanical differential analyser: its principles, development, and application. ROSE, H. E. *Proc. Inst. Mech. Engrs, Lond.*, **159**, *War Emerg. Issue* (*No.* 38) 46–54 (1948).—The instrument gives a graphical or numerical solution of any particular differential equation, if set up with the appropriate end conditions; it does not give a general solution. Integration is carried out by the well-known disc and wheel unit, which is the only one practicable. The complexity of equation is only limited by the number of integrators, 8 being the present maximum. An example is given in which a solution is obtained to an equation which cannot be solved by formal mathematical methods. A machine is under construction in which 30 integrators will be used. An accuracy of about 1% is obtainable without precision-made parts, and about 0·01% when such parts are used. There are also instruments in which the integration is

carried out mechanically, but the coupling between units is electrical. N. C.

518.5

5195. Multiplication and division by electronic-analogue methods. DEELEY, E. M. AND MACKAY, D. M. Letter in *Nature, Lond.*, **163**, 650 (*April* 23, 1949).—The product or quotient of two rapidly varying quantities may be obtained by a modification of the J. J. Thomson method of measuring electron velocity. If the force on an electron, moving with a velocity v in a magnetic field H, is balanced by a force $E \propto Hv$, and if E is automatically and instantaneously varied to achieve this balance, then its value is a measure of the product Hv. A c.r.t. method is described in which v becomes the x-axis velocity v_x, $\propto V_x$ the X-plate voltage, a magnetic field H producing a Y-deflection force $\propto$ the product HV_x. Photo-electric feedback applied to the Y-plates holds the spot on to the x-axis, V_y, the voltage fed back, then being a measure of the product. A simple modification provides quotients. Accuracy is limited by the signal/noise ratio attainable in the feedback path. Some results are summarized. A. J. K.

518.5

5196. A discussion on computing machines. HARTREE, D. R., NEWMAN, M. H. A., WILKES, M. V., WILLIAMS, F. C., WILKINSON, J. H. AND BOOTH, A. D. *Proc. Roy. Soc. A*, **195**, 265–86 (*Dec.* 22, 1948).—The discussion is confined to machines which are automatic, digital and general purpose. It comprises an historical survey, an account of the general principles of control involved (such as the "discrimination" requirement) and notes on the design of the EDSAC and that of a new machine at the NPL (both under construction). A c.r.t. digit store is described, it being possible to store 2 048 digits in a square of 10 cm side on a 6 in tube. 10^9 separate regenerations of a digit, over a period of $4\frac{1}{2}$ hr, have been accomplished without error. A. J. K.

518.5

5197. Decimal point location in computing machines. LUBKIN, S. *Math. Tables Aids Comput.*, **3**, 44–57 (*Jan.*, 1948).—The author suggests that it is better not to locate the decimal point at the extreme left (so that all numbers lie between $+1$ and -1), but to place it several digits away from this extreme. This is supported by considerations of inherent accuracy, of the availability of common integers and constants having values > 1, and of high-precision calculations. Some examples are given. A. J. K.

518.5 : 166

5198. An electrical logic machine. BURACK, B. *Science*, **109**, 610–11 (*June* 17, 1949).—Information about a proposition is represented by contact areas on a wooden block. Placing three blocks in order on a panel chooses a set of circuits. If the corresponding syllogism contains one or more of a set of fallacies the corresponding indicating lamps are lit. The machine was demonstrated in 1936. S. M.

518.5 : 621.317.757

5199. A simple frequency analyser which measures phase. BARBER, N. F. *J. Sci. Instrum. Phys. Ind.*, **26**, 185–7 (*June*, 1949).—The signal to be analysed is made to vary in time the intensity of illumination of a screen consisting of a pattern of diverging transparencies. The shadow cast by this screen falls upon a moving belt of photographic paper. Upon development this paper shows a number of fringe patterns whose various spacings indicate the various periodicities in the signal. The fringe patterns show these periodicities in their correct relative phase. The frequency range and degree of resolution are easily altered. The strength of the various periodicities affects only the intensity of the fringes and cannot be assessed accurately.

518.5 : 621.318.5

5200. A digital computer for scientific applications. WEST, C. F. AND DETURK, J. E. *Proc. Inst. Radio Engrs*, **36**, 1452–60 (*Dec.*, 1948).—Describes the overall organization of the Raytheon binary digital computer, capacity 900 complete operations per second with 15 significant (decimal) figures. There are two main units, together with auxiliary preparation and printing units incorporating decimal-binary conversion: central control; internal (high-speed) memory for numbers and commands, using acoustic Hg delay lines with a capacity of 4 080 "words," access time ~ 380 μsec; magnetic tape memory, capacity of each unit $\sim 200\,000$ words, access rate 500 words/sec; and arithmetic unit, with parallel adding and simultaneous carrying, for the actual computing process: the basic pulse frequency is 2 Mc/s. Continuous monitoring during each operation cycle is provided by the weighted count method [see *Math. Tables Aids Comput.*, **3**, 286–95 (*Oct.*, 1948)], each word or process carrying its own check number; the equipment is $< 0{\cdot}2$ of the total. A. O.

518.5 : 621.318.5

5201. Programme design for a high-speed automatic calculating machine. WILKES, M. V. *J. Sci. Instrum. Phys. Ind.*, **26**, 217–20 (*June*, 1949).—Problems intended to be solved with the aid of a high-speed digital calculating machine must first be reduced to a series of arithmetical operations. These, together with various auxiliary operations required for such purposes as keeping count of the number of times a particular routine has been repeated, must then be expressed in the code appropriate to the machine. The paper contains an account of some of the details of this process, with special reference to the EDSAC. Simple examples are given. These have been specially designed to illustrate the use of conditional orders and the way in which arithmetical operations may be performed on orders.

518.5 : 621.392.

5202. Use of a mechanical harmonic synthesizer in electric wave filter analysis. BROWN, S. L. AND SHARP, J. M. *J. Appl. Phys.*, **20**, 578–82 (*June* 1949).—A mechanical method is described for plotting the effect of the variation with frequency of the series reactance (X_1) and the shunt reactance (X_2) of a filter section. This method permits the quantities $X_1/-4X_2$, $X_1X_2\{(X_1/-4X_2)-1\}$ and $X_1X_2/\{(X_1/-4X_2)-1\}$, from which the characteristics of an electric wave filter are calculated, to be plotted easily as a function of frequency. The cut-off frequencies are located directly from the graphs of N and D [where N/D is either the ratio $X_1/-4X_2$ or $(X_1/-4X_2)$] as functions of frequency, and the

alculation of the attenuation and phase shift at any requency is readily made from the ratio of corre-ponding ordinates of the N and D curves. The mage impedance is determined from the ratio of orresponding ordinates from two additional curves which are mechanical plots of the numerator and the lenominator of the expression for the square of the mage impedance, $X_1X_2\{(X_1/-4X_2)-1\}$ for the nid-series image impedance, and $X_1X_2/\{(X_1/-4X_2)-1\}$ for the mid-shunt image impedance. A.

519.24

5203. Measurement of diversity. SIMPSON, E. H. Letter in *Nature, Lond.*, **163**, 688 (*April* 30, 1949).—A new "measure of concentration" for a population divided into a number of distinct categories is proposed. This new measure is compared with indices proposed by Yule "Statistical study of literary vocabulary" (Cambridge, 1944) and Fisher, Corbet and Williams, *J. Animal Ecol.*, **12**, 42 (1943). N. L. J.

519.24

5204. Overlapping of dust particles on a sampling plate. IRWIN, J. O., ARMITAGE, P. AND DAVIES, C. N. Letter in *Nature, Lond.*, **163**, 809 (*May* 21, 1949).—A theoretical analysis for the case of circular laminae of diameter d distributed over an area A is summarized. The error caused by overlapping is $< 5\%$ if the number of clumps (one or more particles) $< 0{\cdot}0297\,A/d$. J. M. H.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.1 : 531.55

5205. Can we fly to the Moon? HIMPAN, J. AND REICHEL, R. *Amer. J. Phys.*, **17**, 251–63 (*May*, 1949).—A design study of a 3-step rocket employing a bipropellant mixture of fuel oil and tetranitromethane, at a chamber pressure of 20 kg/cm² and temp. 3 260°K, leads to the estimated requirement of 50 000 kg initial mass to project 10 kg payload out of the earth's field. The take-off mass of a rocket carrying a human passenger round the moon is shown to attain fantastic proportions, for any conceivable mixture of chemical propellants. A similar study is made of a hypothetical atomic powered rocket, in which nuclear energy is assumed to heat steam to a temp. of 3 370°K, the steam then being ejected through a nozzle. With these conditions it is estimated that a rocket flight round the moon with safe return would require a take-off mass of $10^5\times$ payload. The direct use of nuclear energy in an imaginary rocket motor, with the nuclear reaction products forming the propellant stream would lead to extremely good mass ratios, but is ruled out because of the excessive power dissipation involved. L. R. S.

522.92

5206. Refractive temperature. COURT, A. *J. Franklin Inst.*, **247**, 583–93 (*June*, 1949).—Limitations to the application of standard refraction tables based on Bessel's formula are discussed in the light of present knowledge of atmospheric conditions. Recent modified compilations are criticized. Approximate assessment of the "refractive temperature" (i.e. the temperature for which the tabulated correction is equal to the true correction) under practical conditions is considered. M. W. O.

523.161

5207. The temperature of interstellar matter. II. SPITZER, L., JR. *Astrophys. J.*, **109**, 337–52 (*May*, 1949).—The processes which tend to dissipate the kinetic energy of interstellar particles are discussed, and the rate of energy loss for each process is derived in a form suitable for numerical computation of interstellar temps. The phenomena considered are: free-free emission by electrons in encounters with protons and H atoms; inelastic encounters of electrons with atoms and with H_2 molecules; excitation of rotational states of H_2 molecules by encounters with H atoms and with H_2 molecules; and inelastic collisions of H atoms and H_2 molecules with solid grains. Application of these and previous results [Abstr. 808 (1948)] to the analysis of interstellar temps. will be made in a subsequent paper. A.

523.161

5208. Polarization of starlight by interstellar dust particles in a galactic magnetic field. DAVIS, L., JR. AND GREENSTEIN, J. L. Letter in *Phys. Rev.*, **75**, 1605 (*May* 15, 1949).—Hall and Hiltner's observations [Abstr. 2309, 2310 (1949)] are explained by the assumptions of (*a*) non-spherical interstellar dust-grains, (*b*) a general galactic magnetic field, (*c*) a tendency for the grains to orientate parallel to the magnetic lines of force, and (*d*) polarization of light transmitted through a cloud of such grains. For the explanation to be valid, the rotation imparted to the grains by collision with interstellar hydrogen must be stopped by either hysteresis effects, or some other mechanism. Agreement with observation is obtained if the ratio of grain axes is 4/3, and 1/6 of the grains are orientated. [See also Abstr. 5222 (1949)]. M. W. O.

523.161 : 523.83

5209. Observations of interstellar H and K, molecular lines, and radial velocities in the spectra of 300 *O* and *B* stars. ADAMS, W. S. *Astrophys. J.*, **109**, 354–79 (*May*, 1949).—Spectrograms of 300 stars of types *O* and *B*, observed with the coudé spectrograph and the 100 in telescope in the region $\lambda\lambda$3600–4700, have been used in a study of the structure of the interstellar H and K lines, of the presence of interstellar molecular and additional atomic lines, and in the measurement of interstellar radial velocities. A.

523.165 : 523.854

5210. Origin of the radio frequency emission and cosmic radiation in the Milky Way. UNSÖLD, A. Letter in *Nature, Lond.*, **163**, 489–91 (*March* 26, 1949).—Recent measurements on galactic radio frequency radiation are discussed in the light of the hypothesis that such radiation, as well as cosmic radiation, originates in (late type) stars showing eruption-activity like the sun but on a scale approximately 10^{11} times as large. W. J. G. B.

523.165 : 550.38 : 621.396.812.5

5211. Microwave sky noise. COVINGTON, A. E. *Terr. Magn. Atmos. Elect.*, **52**, 339–42 (*Sept.*, 1947).—A record of observations correlating microwave sky noise in the 3 000 Mc/s band and the geomagnetic fluctuations experienced in Ottawa during the summer of 1946. A strong relationship is shown between the radiant energy received and periods of magnetic and ionospheric storms and auroral display, but further work is necessary. A. C. C. (R)

523.35

5212. On the existence of the lunar atmosphere. LIPSKI, YU. N. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 4) 465–8 (1949) *In Russian.*—The generally accepted thesis of the non-existence of a lunar atmosphere is based on the failure of attempts to observe general or selective absorption in this hypothetical, and certainly very thin atmosphere, and also the impossibility of determining its horizontal refraction during occultations. By Fesenkov's method [*ibid.*, **39** (*No.* 7) (1943)] which is incomparably more sensitive than any other so far used, it is claimed that the existence of an atmosphere of a density $\sim 1/10\,000$ of the terrestrial atmosphere has been verified, corresponding to a horizontal refraction of $\sim 0{\cdot}2$–$0{\cdot}3''$. The method consists in the determination of the degree of polarization of the celestial background illumination, on a plane situated near the middle of the terminator on the dark part of the disc. The photographic determination was made during the first or last quarter. The 3 factors on which the background brightness depends are: the light of the lit-up part of the moon diffracted in the terrestrial atmosphere (lunar aureole); the light reflected in the direction to the moon from the lit-up part of the earth (ashen light), and the light diffracted in the lunar atmosphere (lunar twilight). As the angle of diffraction during the quadrature is 90°, this component must be totally polarized. The intensity of the ashen light during quadrature is negligible, and the lunar aureole may be considered as partially polarized. The full theory is given. B. F. K.

523.4 : 551.513

The instability of wind discontinuities and shear zones in planetary atmospheres. *See Abstr.* 5816

523.531 : 538.566 : 621.396.11

5213. The diffraction of radio waves from meteor trails and the measurement of meteor velocities. DAVIES, J. G. AND ELLYETT, C. D. *Phil. Mag.*, **40**, 614–26 (*June*, 1949).—Automatic equipment, using pulse technique, is described for photographic recording of the reflected amplitude of the radio waves in time intervals of the order of milliseconds. The theory of the diffraction effect is considered. Fluctuations in reflected amplitude should occur as a meteor crosses the region of the perpendicular from the observing station. Experiments indicate that the initial amplitude fluctuations are associated with many meteor echoes and possess the correct ratios of zone durations predicted by the diffraction theory. The times taken to traverse specified zones are measured so a method is available for measuring directly the velocity of individual meteors. The velocities of meteors in the Geminid shower of 1947, December 11–14, were measured, and the results ag with photographic and visual measurements. L. S.

523

5214. An upper limit to the electron density n the earth's orbit. WHIPPLE, F. L. AND GOSSNER, J. *Astrophys. J.*, **109**, 380–90 (*May*, 1949).—Brightn and polarization observations of the zodiacal li are used to determine the upper limit of the int planetary electron density at one astronomical u The value depends on the assumed distribution law the electrons, a $1/R$ law giving 800/cm³; $1/R$ 900/cm³; $1/R^3$, 1 000/cm³. It is further shown t the observed polarization can probably be account for by reflection of sunlight by dust particles. He the upper limits for the electron density are probal $\geqslant$ the actual value. Certain consequences of th results are discussed briefly.

523.

5215. Hydrogen atmospheres in the absence thermodynamic equilibrium. IV. The solar chrom sphere. GIOVANELLI, R. G. *Aust. J. Sci. Res.* **1**, 360–8 (*Dec.*, 1948).—A discussion of the observ tional data shows that in the range $0 < z < 2{\cdot}5$ 10^8 cm the electron concentration in the lo chromosphere may be expressed as

$$N_e = 5 \times 10^{11} \exp(-6 \times 10^{-9} z) \text{ cm}^3$$

where z cm is the height measured from a le 500 km above the base of the chromosphere. It shown that above the 500 km level H atoms a almost completely ionized, and that with hydrosta equilibrium the observed density gradient corresp to a temp. of $2{\cdot}7 \times 10^4$ °K. This is in good agreem with the temp. derived by Redman from line pro measurement, so that the lower chromosphere appe to be effectively in thermal and hydrostatic equi brium. Estimates of lower accuracy are given for t electron concentrations at some higher levels in t chromosphere. A discussion is given of the mechani of absorption of Hα radiation by a chromosph whose temp. is well above that of the photosphere.

523.

5216. The partition function for the elements in t solar atmosphere. CLAAS, W. J. *Proc. K. N Akad. Wet.*, **52** (*No.* 5) 518–25 (1949) *In English.* The distribution of the atoms of the various elme over all excitation stages is studied owing to its i portance for the interpretation of the solar spectru In particular, the partition function for a neutral at and for the corresponding ion is investigated, wi special consideration of the influence of perturbi particles in the atmosphere, which prevent t formation of higher electron orbits. A.

523.

5217. Line strengths in the iron spectrum in int mediate coupling with application to the solar curve growth. GOTTSCHALK, W. M. *Astrophys. J.*, 1 326–37 (*Sept.*, 1948).—The author intends his wo to provide a beginning for tables of theoretical li strengths. The computations are carried out means of quantum mechanics for the transitio $3d^7(^4P)4s - 3d^7(^4P)4p$ and $3d^7(^4F)4s - 3d^7(^4F)4p$ Fe I. Reasonable agreement with experimen values is found. A curve of growth is derived for t

in, giving for the temperature of the reversing layer 800 ± 200°K. A. B.

523.774 : 523.877

5218. On the chemical composition of the sun from its internal constitution. HARRISON, M. H. *Astrophys. J.*, **108,** 310–25 (*Sept.*, 1948).—The complete theory of a stellar model is given for which the chemical composition is constant throughout the star, the radiation pressure negligible, the star consisting of a convective core and an envelope in radiative equilibrium, the entire energy generation from nuclear sources occurring within the convective core, and which, in particular, contains the heavy elements in a combination of 30% Russell mixture and 70% oxygen group (C, N, O, Fe, Ne). At the existing temperatures of some 20 million degrees the atoms of these latter elements are beginning to be stripped to their bare nuclei and their contribution to the opacity decreases rapidly. The abundances of H and He as functions of the O abundance are calculated and compared with spectroscopic data. The author concludes that there appears now to be no divergence in the absolute abundance of H and the important H/He ratio as determined from stellar atmospheres and the theory of the internal constitution. A. B.

523.774 : 523.877

5219. On the physical and chemical composition of the sun. KELLER, G. *Astrophys. J.*, **108,** 347–53 (*Nov.*, 1948).—The relative abundance of hydrogen (X), helium (Y), and of the group comprising all the heavier elements together (Z), as well as the abundance-ratio O/Z of the oxygen group of elements (O) to the heavy group (Z), can be calculated from mass, luminosity, and radius of the sun by using the mean of the observed apsidal motion of 6 available main-sequence stars. The latter value leads to an effective polytropic index 3·7, and finally to the stellar model derived by the author: $X = 0{\cdot}67$, $Y = 0{\cdot}29$, $Z = 0{\cdot}045$, and $O/Z = 0{\cdot}85$. These values are intermediate between M. Schwarzschild's Russell-mixture model ($O/Z = 0{\cdot}50$) and Keller's original oxygen model (1·00); they are also compared with recent work by Biermann [*Z. Astrophys.*, **22,** 244 (1943)]. Satisfactory agreement is found with Unsöld's and Aller's empirical data based on the few available spectroscopic analyses of stellar atmospheres. A. B.

523.842

5220. Further note on the distribution of the longitude of periastron. SCOTT, E. L. *Astrophys. J.*, **109,** 446–51 (*May*, 1949)—The distribution of ω, the longitude of periastron, was analysed for 85 eclipsing and 330 non-eclipsing spectroscopic binaries listed in the Fifth Catalogue as having elliptic orbits. The analysis was performed separately for various categories of binaries obtained from classifications and cross-classifications according to spectral class, semi-amplitude, period, and eccentricity. In general, the results of the analyses are consistent with the Struve hypothesis that the catalogue values of ω are distorted by systematic errors due to some phenomenon occurring in the vicinity of the binary. However, some curious results were obtained. The most striking of these is that there is strong evidence of non-uniformity in the distribution of ω among binaries with period from 2 to 5 days, while there is no such evidence for binaries with period shorter than 2 days. A.

523.842

5221. Stars with invisible companions. LARINK, J. *Naturwiss.*, **35** (*No.* 4) 118–20 (1948) *In German.*—Critical survey of recent discoveries (mainly by Reuyl and Holmberg's investigation of parallax-stars) which have completely or nearly filled the gap between massive celestial bodies (the stars) and the smaller bodies (mass $\simeq 1/1\,000$) which were until now only known as planets in our solar system. A. B.

523.87 : 551.594.5

The excitation of forbidden lines by electron impacts—nebulae, novae, polar aurorae. *See Abstr.* 5821

523.872 : 535.51

5222. On the presence of polarization in the continuous radiation of stars. II. HILTNER, W. A. *Astrophys. J.*, **109,** 471–8 (*May*, 1949).—Observations are presented which establish that radiation from distant galactic stars is polarized and that this polarization is independent of wavelength. An attempt was made to establish a relationship between polarization and reddening. Although a close correlation is not evident, polarization has not been observed in unreddened stars. A possible mechanism for explaining the observations is briefly discussed. [See also Abstr. 14 (1948), 5208 (1949)]. A.

523.877

5223. The empirical basis of the theory of stellar evolution. JORDAN, P. *Acta Phys. Austriaca*, **2** (*Nos* 3–4) 356–67 (1949) *In German.*—The author's cosmological theory [Abstr. 662 (1940)] is tested by recent empirical results, derived from new methods in the observation of spiral nebulae (mainly Baade's work on their resolution and the existence of two kinds of star populations [Abstr. 821 (1945)]), supernovae (Baade's and Minkowski's investigation of the three historical galactic supernovae) and cosmic radiation. Theoretical results by v. Weizsäcker on the origin of the solar system, the spiral nebulae and globular clusters [Abstr. 1390 (1948)] and Chandrasekhar's theory of degenerate stars are re-discussed, as well as recent work by Klein, Beskow and Treffenberg on the origin of the chemical elements [Abstr. 414 (1947)]. The author concludes that some of the new facts favour his hypothesis and that none of them lead to contradictions. A. B.

523.877

5224. Nonradial oscillations of the standard model. KOPAL, Z. *Astrophys. J.*, **109,** 509–27 (*May*, 1949).—The differential equations governing small non-radial oscillations of compressible-gas spheres are set up correctly to the order of accuracy to which the changes in the gravitational potential produced by such oscillations can be ignored. Explicit forms of these equations are obtained for the polytropic family of models and are integrated mechanically, for the case of the standard model (polytrope $n = 3$), by means of the M.I.T. differential analyser, with the aim of ascertaining free periods of the lowest 3 "gravitational" oscillations which correspond to the second-, third- and fourth-harmonic disturbance. A whole march of the corresponding pressure and

density variation throughout the interior of the oscillating configuration is tabulated for all characteristic frequencies established in this paper, and the frequencies themselves are ultimately corrected for the main part of the error inherent in the initial neglect of the accompanying gravity changes, by Cowling's perturbation method. A.

523.877

5225. The Stark effect of the higher Balmer lines in stars of spectral types *A* and *B*. VAN DIEN, E. *Astrophys. J.*, **109**, 452–70 (*May*, 1949).—The purpose of the investigation was to compute the number of Balmer lines which should be visible in a stellar spectrum on the following assumptions: (1) the stellar atmosphere consists of H only; (2) the static Stark effect is the only agent of line broadening; (3) the stellar atmosphere is uniformly stratified in gravitational equilibrium. For the probability distribution of the field strength in an ionized gas, Holtsmark's theoretical results were used, as modified by Verweij. For the Stark pattern of the higher Balmer lines a simplifying assumption was introduced, suggested by Pannekoek. Eddington's equations of radiative transfer were integrated numerically for a number of wavelengths between 3 660 Å and 3 750 Å and for the following atmospheres: surface temps. 10 080°, 12 600°, 16 800°, and at each temp. surface gravities 10^2, 10^4, 10^6, 10^8. The values of the coeff. of continuous absorption for H were taken from published computations by Pannekoek. The theoretical results were compared with 3 groups of observational data: bright stars, eclipsing binaries, and 2 white dwarfs. The white dwarfs seem to conform to the theoretical expectations; but here the data on mass, radius and temp. are more uncertain than for the 2 other classes of objects. It was found that in a large number of stars of the first 2 groups more H lines can be observed than are predicted by theory. In many of these stars the effective surface gravity seems to be $\leqslant 1/100$ of the dynamical value. This agrees with results of Schalén and of Pannekoek and Reesinck. Several possibilities are investigated which might account for the discrepancy found. Radiation pressure and electron scattering may, in a few cases, have some effect but not to an extent sufficient to explain all th disagreement. In the temp. range considered, th absorption by negative H ions is negligible. It suggested that stellar atmospheres are not bu according to the model which assumes equilibrium ar stratification under the influence of gravitation ar radiation pressure.

523.87

5226. Superthermic phenomena in stellar atm spheres. III. The chromospheric radiation fiel THOMAS, R. N. *Astrophys. J.*, **109**, 480–99 (*Ma* 1949).—The solution for the chromospheric values of Paper II [Abstr. 2932 (1949)] is extended the case in which the chromospheric radiation ar absorption is included in the radiation field. Th variety of the solution which takes into accou absorption in the chromospheric Balmer lines predic a Balmer decrement in the flash spectrum whic agrees well with the observations. Earlier work c the theoretical Balmer decrement has neglecte radiative excitation in the Balmer lines, and th assumption's physical usefulness is here questione The most likely N_e value and the relation betwee density and emission gradients are discussed.

523.87

5227. Superthermic phenomena in stellar atm spheres. IV. The Wolf–Rayet atmosphere. THOMA R. N. *Astrophys. J.*, **109**, 500–8 (*May*, 1949).— The structure of the Wolf–Rayet atmosphere is co sidered from the standpoint of stratification ar support. It is concluded that the neglect of deviatio from the Boltzmann–Saha relations in earlier analys obscured an ambiguity in the interpretation of th observations and that a homogeneous atmosphe with $T_e > T_r$ is as acceptable as a stratified atmosphe with T_e increasing downward. Analysis of the densi gradient in V444 Cygni leads to the conclusion th non-isotropic macroscopic motions of velocity equ to that inferred from the emission-band width suffic for support of the atmosphere. Comparison of th (ionization, bandwidth) correlation with the velociti required for support suggests that the ionizatio increases outward in at least the lower atmosphere.

PHYSICS 53

53

5228. Letter symbols for physics. *Amer. Stand. Z*10.6—1948 [*Amer. Soc. Mech. Engrs*] 40 *pp.* (1948).—About 800 recommended letter symbols are given (not abbreviations for units). They are arranged alphabetically in two lists, (*a*) in order of the quantity represented, (*b*) in order of the symbol. Rules for the use of subscripts and superscripts are given, and typographical directions.

53.081

5229. The natural system of units. [*Das Natürliche Mass System*]. OBERDORFER, G. *Springer-Verlag. Vienna* (1949) 34 *pp.*, 2 *tables*. *In German.*—The basic concepts for the establishment of a comprehensive system of units are examined. A "natural" system is proposed with length (l), time (t), and action (H) as fundamental mechanical dimensions, and electrical charge (Q) and magnetic flux (Φ) where $(H) = (Q)($ as electromagnetical. The units are m.k.s., and m, ampere and volt, respectively. Bodea's [Abstr. 214 (1947)] concept of temperature is adopted, the unit heat being the Joule, and of temperature th Carnot = Joule/mol. S. V

53.08

5230. Ninth International Conference of Weigh and Measures. *Nature, Lond.*, **163**, 427–8 (*March* 1 1949).—A summarized report of the proceedings hel in Paris in October 1948. The replacement of th Pt–Ir metre standard by a unit of length based on th wavelength of light emitted by a source of Kr^{84} Hg^{198}, and the experimental value of the acceleratio due to gravity, were considered. A revised text of th International Temperature scale was accepted, an it was agreed that the thermodynamic scale should b

sed on + 0·0100 degree, the triple point of water, gether with the absolute zero, and that the unit of at be the "Joule." The recommendation that for uropean countries words ending in "—illion" refer powers of 10^6 was approved. S. W.

53.081 : 537 : 537.71 : 621.3.081

31. Some units in the Giorgi system and the G.S. system. HALLÉN, E. *Acta Polytech.* (*No.* 11, 47) [*Phys. and Appl. Math., Ser.* 1 (*No.* 2). Also *kn. Hogsk. Handl.* (*No.* 6)] 43 *pp. In English.*—ssuming the definition of the electric current unit rived from magnetic forces between currents, the thor investigates theoretically which formulation other magnetic laws are logically possible. The sult is that only the unit ampere-square meter and t the volt-second meter can be used for the magnetic oment, and that the oerstedt must be abampere/cm. he author describes experiments comparing "mag-tic pole strength" considered as equal to the *B*-flux, d "magnetic pole strength" considered as equal to e *H*-flux. The latter conception is shown to be the rrect one. A.

FUNDAMENTALS 530.1

530.1 : 550.38

232. Rotation and terrestrial magnetism. GOLD, T. *ature, Lond.*, **163,** 513–15 (*April* 2, 1949).—A report n a Geophysical Discussion of the R.A.S. on Wilson's fundamental" hypothesis of the origin of the earth's agnetic field. The observational evidence is stated s well as the severe objections which can be raised gainst any formulation of the hypothesis on heoretical grounds. H. B.

530.12

233. Radially symmetric distributions of matter. VYMAN, M. *Phys. Rev.*, **75,** 1930–6 (*June* 15, 1949).—everal of the known solutions of the Einstein field quations are re-examined and it is shown that these olutions are special cases of more general solutions f the field equations. The explicit solution of the eld equations in terms of known functions is also ound for the case of Volkoff's massive spheres. In he last section of this paper a mathematical procedure or generating solutions of the field equations is utlined. A.

530.12

234. Action as a co-ordinate of space. II. RUMER, U. B. *J. Exp. Theor. Phys., USSR,* **19** (*No.* 3) 07–14 (*March,* 1949) *In Russian.*—For I, see Abstr. 326 (1949). It is shown that a unitary theory of ravitation and electricity results as a special case of he general theory of the 5-field, determining the netrics of the 5-space of co-ordinates, time and ction. B. F. K.

530.12 : 538.566 : 621.392

235. Relativistic transformation of cylindrical electromagnetic waves. GARELLI, C. M. AND MALVANO, R. *Nuovo Cim.*, **6** (*No.* 3) 200–6 (*May* 7, 1949) *In Italian.*—Formulae are given showing how frequency, phase velocity, attenuation, etc., transform in passing to a system of reference in motion along the direction of propagation, for the case of waves of the types which propagate in cylindrical waveguides. L. P.

530.14

5236. Note on the anomalous magnetic moments of the heavy particles. YAMASAKI, Z. AND UMA, S. *Proc. Phys.-Math. Soc. Japan,* **24,** 207–10 (1942) *In English.*—The anomalous magnetic moments of the heavy particles were calculated both in the vector and pseudoscalar meson theories, following the method of Ma [Abstr. 2514 (1940)]. S. C. A. P.

530.14

5237. Interaction between nucleons. ARAKI, G. *J. Phys.-Math. Soc. Japan,* **16,** 235 (1942).—One of serious difficulties in the meson theory is that the interaction potential increases as $1/r^3$ when the distance r between nucleons decreases. A possibility of removing this difficulty is pointed out by introducing the reaction of the field in the similar manner as the case of scattering problem. S. C. A. P.

530.14

5238. Stationary state of vector mesons. OGATA, S. *J. Phys.-Math. Soc. Japan,* **17,** 498–9 (1943).—The wave equations of vector mesons were solved in the electrostatic field with well form potential, and the stationary solution obtained. The eigenvalues are not complex at a certain depth of the potential well contrary to the case of scalar mesons. S. C. A. P.

530.14

5239. Direct interaction between nuclear particles. MIYAZIMA, T. *J. Phys.-Math. Soc. Japan,* **16,** 236–7 (1942).—In usual field theories the direct interaction between nuclear particles of the same kind is avoided as far as possible. Here a method to treat the direct interaction explicitly has been tried. S. C. A. P.

530.14

5240. Meson pair theory of nuclear force. OZAKI, S. *J. Phys.-Math. Soc. Japan,* **16,** 209–11 (1942).—The nuclear force between nucleons of the same kind as well as of different kinds can be explained by exchange of a pair of charged mesons instead of neutral mesons. But the result on the scattering cross-section of mesons of the energy 10 eV due to nucleons is about 10^{-23} cm², which is much different from the experimental result of Wilson and others. S. C. A. P.

530.14

5241. Interaction of mesotrons and nucleons. TOMONAGA, S.-I. *J. Phys.-Math. Soc. Japan,* **16,** 79–81 (1942). S. C. A. P.

530.14

5242. The classical self-energy of elementary particles. WATANABE, S. *Proc. Phys.-Math. Soc. Japan,* **23,** 975 (1941) *In English.*—A way of avoiding the difficulty of infinite self-energy of the elementary particles is indicated by representing the elementary particle as a geometrical point in space-time occupying, however, a definite finite region in the fifth dimension. S. C. A. P.

530.14

5243. Negative intrinsic mass and positive charge. WATANABE, S. *Proc. Phys.-Math. Soc. Japan,* **23,** 973–4 (1941) *In English.*—In the five-dimensional theory of field, in which the intrinsic mass of a particle

is considered as fifth component of the energy-momentum vector, the possibility of a negative intrinsic mass has been discussed, and it is pointed out that the negative mass means positive charge.

S. C. A. P.

530.14 : 537.21

5244. Gravitational interaction between electrostatic and "mesostatic" fields. FISHER, I. Z. *J. Exp. Theor. Phys., USSR*, **19**, 271–2 (*March*, 1949) *In Russian.*— Referring to earlier work [Abstr. 44 (1949)], where the author showed that the potential of the scalar "mesostatic" field in the neighbourhood of a point source, considering gravitation effects, has a logarithmic character, it is pointed out that this sensitivity of the scalar field to gravitation is even more marked in the gravitation field of spherical symmetry around an insulated particle carrying electric and quasi-electric meson charges. The author has solved this problem by a method similar to that given in the earlier paper. The conclusion is that the electrostatic field is only very slightly excited by the scalar potential field, whilst the latter itself varies very considerably and loses its character at the point $r = 0$. This implies that the total energy of the "mesostatic field" converges; the parts of the energy due to the electrostatic and gravitational fields, however, diverge as before. B. F. K.

530.14 : 539.18

5245. Polarization effects of vector-mesons. WENTZEL, G. *Phys. Rev.*, **75**, 1810–14 (*June* 15, 1949).— Adopting a vector-meson model for the π-meson the following are studied: (i) the polarization of π-mesons produced in nucleon-nucleon-collisions; (ii) the angular distribution of μ-mesons resulting from π-μ-disintegrations, as depending on the polarization of the π-mesons; (iii) the effect of electromagnetic fields on this polarization, in particular; (iv) the depolarization caused by the electric fields in matter. The theoretical results are encouraging for an experimental investigation. A.

530.145

5246. On generalizing boson field theories. GREEN, A. E. S. *Phys. Rev.*, **75**, 1926–9 (*June* 15, 1949).— If a boson field theory is generalized to admit in the field Lagrangian all the derivatives of the field co-ordinates up to the σth in a particularly symmetrical way, then one finds that in the final expression for the interaction energy of fermions the usual interaction is replaced by a weighted sum of σ such interactions, where the relative weight factor and the boson mass associated with each interaction are given uniquely by algebraic relationships involving the constants appearing in the field Lagrangian. One can thus formulate a simple principle for obtaining the interaction energy according to a multiple-boson theory of the form suggested by these generalizations if the interaction energy is known for the one-boson case. The principle is then applied to the non-relativistic and relativistic interaction terms for electrons according to electrodynamic (photon) field theory, and for nucleons according to the meson field theories investigated by Kemmer. One finds that in almost every case the weight factors are such that not only are the inadmissible R^{-3} and R^{-2} singularities removed, but also in 3- and 4-boson theory, the objectionable R^{-1} singularities. A closely relat result is the fact that generalization justifies t neglect of short wavelengths in the evaluation of t interaction and self-energy integrals.

530.1

5247. Particles with spin and the principle reciprocity. CHENG, K.-C. AND RODRIGUEZ, A. Letter in *Nature, Lond.*, **163**, 367–8 (*March* 5, 1949). Equations based on the reciprocity principle a given for particles of spin $\frac{1}{2}$. The theory allows particle of zero mass (neutrino) and a large number other particles whose masses are determined by tw equations involving Laguerre polynomials. It suggested that in this theory the electron wou appear as a charged neutrino. G. J.

530.14

5248. The meson fields and the equation of moti of a spinning particle. MAJUMDAR, R. C. AND GUPT S. *Phys. Rev.*, **75**, 1788–93 (*June* 15, 1949). Following Riesz, the meson fields generated by point dipole at a point outside the world line ha been defined in terms of the derivatives of an integ which is an analytical function of a parameter, and converges for α lying between $2 < \alpha < 3$. It then shown that by the process of analytical co tinuation of the parameter to the value $\alpha = 2$ f which the Riesz fields satisfy the fundamental meso field equations, one not only obtains the classic Liénard–Wiechert–Bhabha fields at a point outsi the world line but also a field at a point on the wor line itself which is finite and represents the reactic of the field correctly. The equations for rotation and translational motions follow immediately fro the usual electrodynamical equations of a dipo given by Frenkel. The equations thus obtained a free from singularities and do not contain a arbitrary constant except the mass and spin angul momentum of the dipole.

530.14

5249. Meson theory involving a mixture of scal and pseudoscalar field. I. YAMASAKI, Z. *Proc. Phys. Math. Soc. Japan*, **25**, 659–66 (1943) *In English.*— Attempts were made to improve the meson theor i.e. to remove the first kind of difficulties, which a common to all quantum field theories, by assumi that the co-ordinates of the heavy particle are repr sented by complex quantities [cf. Yamasaki, *ibid* **24**, 821 (1942)], and to remove the second kin which is proper to the meson theory and depends o the assumption on the wave function, by adoptin the theory involving the mixture of scalar an pseudoscalar meson fields. S. C. A.

530.14

5250. Meson theory involving a mixture of scal and pseudoscalar fields. II. YAMASAKI, Z. *Pro Phys.-Math. Soc. Japan*, **26**, 32–40 (1944) *In English.*— The theory of the deuteron and theory of the cosm radiation are treated by the method described in th previous paper [preceding Abstr.]. S. C. A.

530.14

5251. Ladder method applied to continuous lev eigen-functions. YAMAMOUCHI, T. *Proc. Phys Math. Soc. Japan*, **23**, 764–5 (1941).—Thoug the factorization method due to Schrödinger fo

olving differential equations in quantum mechanics limited to the discrete level eigen-functions, was shown that it can be utilized effectively for btaining the recurrence formulae and would be seful in the computation of the eigen-functions and eir derivatives for Coulomb fields, which is often ecessary for normalizing continuous level eigen-nction of electron in the field of an ion. S. C. A. P.

530.145

5252. Divergence difficulty and mixed meson theory. ARAKI, G. *Progr. Theor. Phys.*, **3**, 422–38 (*Oct.–Dec.*, 1948) *In English.*—The detailed calculations of ome conclusions already published [Abstr. 4472 1949)]. G. J. K.

530.145

5253. A note on the Riesz method and the method of esidues. AULUCK, F. C. AND KOTHARI, D. S. *Proc. Roy. Soc. A*, **198**, 170–3 (*Aug.* 15, 1949).—It is shown hat the Riesz method of analytic continuation nd the method of residues give the same results in he classical electromagnetic theory of a point source. A.

530.145 : 517.9

Sommerfeld's polynomial method in the quantum heory. *See Abstr.* 5190

530.145 : 537.122

5254. Magnetic polarizability of the electron. GUPTA, S. N. Letter in *Nature, Lond.*, **163**, 686 (*April* 30, 1949).—Following the method of Luttinger [Abstr. 1694 (1949)] for the anomalous magnetic moment of the electron, the energy of a particular state in a magnetic field is obtained to the next term in H^2 to give the polarizability. The new terms are finite but negligibly small, except that there appears a term in $H^2 \log H$. Higher order terms seem to be convergent also. G. J. K.

530.145 : 537.122

5255. Some questions of classical electrodynamics concerning the motion of the electron. ZIN, G. *Nuovo Cim.*, **6**, 1–23 (*Jan.*, 1949) *In Italian.*—Dirac's classical equations of motion for the electron are known to lead to results in disagreement with experiment, for instance in the problem of the collision of an electron with a proton. Eliezer [see Abstr. 1129 (1947)] introduced advanced besides retarded potentials, and succeeded in removing some of these difficulties. The present paper proves that Eliezer's equations lead to unacceptable results in the case of harmonic oscillator. L. P.

530.145 : 539.18

5256. Meson masses and the principle of reciprocity. BORN, M. AND RODRIGUEZ, A. E. Letter in *Nature, Lond.*, **163**, 320–1 (*Feb.* 26, 1949).—With reference to previous letters by Born and Green [Abstr. 2331, 2334 (1949)] numerical results of a proposed new theory of elementary particles and quantized fields are given. If a certain absolute length occuring in this theory is identified with the classical electron radius numerical values for the expected meson masses in terms of the electron mass are given by $m = \hbar\sqrt{(x)}c/e^2$ where x is a root of the equation $L_n^{(1)}(x) = 0$ and the functions equated to zero are the Laguerre polynomials of the first kind. The value of $m = 192$ found for $n = 1$ is proposed for the mass of the most stable meson. There is an infinite number of possible meson masses. H. M.

530.145 : 539.18

Phenomenological description of nuclear forces and meson properties. *See Abstr.* 5673

530.145 : 539.18 : 537.591.1

Cosmic ray mesons and meson theory. *See Abstr.* 5517

530.145.6

5257. Field potentials and the generalized gauge transformation in the theory of particles with spin. KWAL, B. *J. Phys. Radium*, **10**, 189–94 (*June*, 1949) *In French.*—The generalized gauge transformation of wave equations are described in the spinor form. A knowledge of the sources of the field is an important part of the process. The case of spin 1 is examined in detail, and distinctions are drawn between the Maxwell and meson fields from this point of view. G. J. K.

530.145.6

5258. Determination of the phase of the wave function in particle scattering. DRUKAREV, G. F. *J. Exp. Theor. Phys., USSR*, **19**, 247–50 (*March*, 1949) *In Russian*—A new method is presented, in which the phase is determined as an asymptotic value of a certain auxiliary function satisfying the non-linear 1st-order differential equation. This method results in a more exact determination than can be obtained by the numerical integration of the Schrödinger equation. B. F. K.

530.145.6

5259. Two-component wave equations. JEHLE, H. Letter in *Phys. Rev.*, **75**, 1609 (*May* 15, 1949).—The transformation properties of the 2-component wave-equation $\gamma_\mu(\partial/\partial x_\mu - i\phi_\mu)\psi = x\psi^*$ are considered, and the formulation of Lorentz covariance. G. J. K.

530.145.6 : 539.18

5260. On the wave equations of the theory of a particle of spin ($h/2\pi$) and their generalizations. PETIAU, G. *J. Phys. Radium*, **10**, 215–24 (*June*, 1949) *In French.*—An extension of a method of deriving these equations through the close coupling of two particles of spin $\frac{1}{2}$ with different masses leads to a representation of a particle of spin 1 with several mass states. In particular the theory rediscovers and interprets the results of some previous authors. G. J. K.

530.145.63 : 538.11

5261. Strings, poles and the electron. ELDRIDGE, J. A. Letter in *Phys. Rev.*, **75**, 1614–15 (*May* 15, 1949).—A brief discussion of the angular momentum of the field of a point charge e and 2 associated magnetic poles $\pm g$ leading to simple results in the Dirac theory [Abstr. 1703 (1949)]. G. J. K.

530.162

5262. Unsteady phenomena. KAPPLER, E. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of liquids and gases*," 261–6 (1948) *In German.*—The work of Scheffers [*Z. Phys.*, **117**, 444 (1941)] on the general theory of the unsteady state is reviewed, and recent work on the derivation of Nyquist's formula is discussed. Kappler's study of the Brownian movement [Abstr. 626 (1940)] and experimental

equipment for the measurement of fluctuations are also reviewed. [See Abstr. 5284 (1949)]. L. S. G.

530.162 : 539.18

Some considerations regarding the masses of mesons. *See Abstr.* 5675

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.19

5263. A simple treatment of statistical mechanics of a one-dimensional substance. TAKAHASI, H. *Proc. Phys.-Math. Soc. Japan*, **24**, 60–2 (1942) *In German.*—Statistical mechanics of a one-dimensional substance was treated exactly without assuming any special form of potential function of interaction between the nearest neighbours. It is pointed out that the coexistence of two phases in a one-dimensional substance is impossible, whatever form of potential function might be taken. S. C. A. P.

531.19

5264. Thomas–Fermi's equation at any temperatures. SAKAI, T. *Proc. Phys.-Math. Soc. Japan*, **24**, 254–60 (1942) *In English.*—A generalized form of Thomas–Fermi's equation which is valid at any temp. and density of electrons, was derived by combining statistical-mechanical relations with the theorem from thermodynamics that the total free energy of a continuous medium at a given temp. should take a min. value if there is no external work done on the system. The problem of finding a quantity corresponding to the thermodynamic potential per electron was studied, and it was shown that it is constant everywhere in the medium when there is an elec. field produced by the charged particles themselves. S. C. A. P.

531.19

5265. The derivation of statistical expressions from Gibbs' canonical ensemble. ANSBACHER, F. AND EHRENBERG, W. *Phil. Mag.*, **40**, 626–31 (*June*, 1949).—An elementary method, not involving Stirling's formula or the method of steepest descent, is used to obtain the known expressions for the average energy distribution of assemblies of particles obeying the Boltzmann, Einstein–Bose or Fermi–Dirac conditions. The method involves the use of the partition sum associated with the ensemble. L. S. G.

531.19 : 530.145.61

5266. The zero-point energy of a system of particles. DINGLE, R. B. *Phil. Mag.*, **40**, 573–8 (*May*, 1949).—An estimate of the energy of a gas of hard spherical particles is made by a variational method, given the mean inter-particle distance. The particles satisfy Einstein–Bose statistics, and the result is applicable to helium II [Abstr. 1874 (1949)]. A preliminary to He calculation is the construction of the wave-functions of the relevant Schrödinger equation.

L. S. G.

531.31

5267. Impulses and constraints in classical mechanics. BUCKLEY, R. AND WHITFIELD, E. V. *Appl. Sci. Res.*, **A 1** (*No.* 4) 306–12 (1949) *In English.*—The impulsive motion of a dynamical system subject constraints is considered in terms of the geometry the configuration space, which for this kind of moti is Euclidean. Tensor analysis also reduces to tens algebra in this case. Theorems due to Kelvi Bertrand and G. I. Taylor are obtained by t method, and its relationship to relaxation methods indicated. G. C. Mc

531.5

5268. On the motion of rockets. MATTHIEU, *Schweiz. Arch. angew. Wiss. Tech.*, **15**, 129–37 (*Ma* 1949) *In German.*—Derives the fundamental equatio of rocket motion in the case of air-resistance.

MECHANICAL MEASUREMENTS 531.7

531.74 : 535.4

5269. Measurement of small surface angle BARAKAT, N. Letter in *Nature, Lond.*, **163**, 6 (*April* 16, 1949).—In using fringes of equal chroma order to measure the angle of a wedge it is necessa to rotate the specimen in order to locate the maximu angle. It is shown that the wedge-angle can obtained directly by the superposition of fringes equal chromatic order and Fizeau fringes. An ang of $\tan\theta = 0{\cdot}001$ was measured, with a suggest accuracy of 1% even in an unfavourable case. H. H. HO

531.78 : 531.225 : 621.317.

5270. Measurement of torque in shafts. FORD, AND DOUGLAS, A. *Engineering*, **107**, 481–4 (*May* 2 1949).—A survey of methods of measuring torq comprising descriptions of the early "sleeve" a "disc" type torsionmeters and later versions usi stylus-on-celluloid recording; electromagnetic a capacity torquemeters and electrical resistance stra gauge torque recorders. The advantages and d advantages of each method are discussed. H. J. H.

MECHANICS OF FLUIDS 532

532.

5271. On the mechanism of viscosity of liqui TELANG, M. S. *J. Chem. Phys.*, **17**, 536–9 (*Ju* 1949).—A new viscosity-temperature relationship f liquids has been derived, and its application has be studied. The derivation is based upon the theory viscosity by Eyring *et al.*, rectifying the "activati energy" term. The "activation energy" term h been shown to be equivalent to the free energy formation of a surface and the error committed previous workers regarding the evaluation of "acti tion energy" has been discussed. The propos equation is free from any arbitrary or empirical ter and since, in particular, it does not involve a quantities derived from viscosity measurements, makes a direct calculation of viscosity possible.

532.5 : 53

5272. Mathematical foundations of fluid mechani WALTER, A. [Senior author]. *FIAT Rev. Germ*

ci. (1938–46) [*Off. Mil. Govt. Germany*] "*Applied Mathematics, III*," 202 *pp.* (1948) *In German.*—ractically all the German theoretical research work n fluid mechanics, for the period 1939–46, is dis-ussed, and a complete bibliography of published esults is given. Separate sections are devoted to: 1) perfect fluids [Görtler, H.], (2) viscous fluids Görtler, H.], (3) turbulent flow [Görtler, H.], 4) dynamics of gases [Shaer, R.], (5) heat trans-nission [Wieghardt, K.], (6) wings, airscrews, pumps nd turbines [Wieghardt, K.], (7) hydraulics [Karas, ..], (8) dimensional analyses [Schiller, L.]. Section 4) is exhaustive. Linear approximation methods are iscussed, and recent work on series developments, eration methods and transformation methods is ointed out. The method of characteristics is sur-eyed and solutions with discontinuities are studied. L. S. G.

532.511

5273. The general problem of limits for the con-inuous space-time functions and the integral equations f hydrodynamics. GIÃO, A. *C.R. Acad. Sci., Paris*, **228**, 1275–6 (*April* 11, 1949) *In French.*—From certain efined functions, by a generalization of the analysis f Oseen for incompressible fluids, integral equations f hydrodynamics are obtained for any fluid motion, whatever be the compressibility and viscosity of the luid. The detail of calculation is to follow. G. G.

532.582.3

5274. Forces exerted on a rigid cylinder in a iscous fluid between two parallel fixed planes. FAXÉN,). H. *Acta Polytech.* (*No.* 2) (1947) [*Phys. and Appl. Maths. Ser. Vol.* 1 (*No.* 1). Also *IngenVetensk. Akad. Handl., No.* 187] 13 *pp. In English.*—Resistance ormulae are calculated under the following assump-ions: (1) The cylinder is moving in the fluid parallel o the planes and in the plane midway between them; he fluid is at rest at a distance from the cylinder. 2) The cylinder is fixed in the middle plane, and the luid is flowing between the planes past the cylinder. he result is expanded into series of λ, the quotient f the cylinder's diameter and the distance between he planes. The method may also be used in some roblems of elasticity. Incidentally, forty roots of he equation $\sinh 2\kappa = 2\kappa$ are calculated to ten places or more. A.

532.582.3

5275. Hot-wire investigation of the wake behind ylinders at low Reynolds numbers. KOVÁSZNAY, . S. G. *Proc. Roy. Soc. A*, **198**, 174–90 (*Aug.* 15, 949).—The hot-wire technique has been used to measure the regular vortex street pattern behind a ylinder at low Reynolds number. Measurements of mean velocity distribution were made both below and above the critical Reynolds number at which the periodic motion appears. Amplitude and phase measurements gave sufficient information for com-putation of the instantaneous flow pattern of the vortex system. The important points resulting from he investigation are that (i) the critical Reynolds number at which vortices are shed is 40, (ii) in the ange of Reynolds numbers investigated the vortices re not shed directly from the cylinder but appear ome distance downstream as an instability of the aminar wake. A.

532.595

5276. Annular waves on the surface of a rotating liquid. SRETENSKI, L. N. *Izv. Akad. Nauk, USSR Otdel. Tech. Nauk* (*No.* 1) 5–18 (*Jan.*, 1949) *In Russian.*—The problem treated is that of the oscilla-tions about the position of equilibrium represented by the paraboloidal surface of a rotating fluid in a cylindrical vessel. The movement of the liquid is considered by reference to a stationary co-ordinate system and by the introduction of Lagrangian co-ordinates. The Lagrange equations are found for the excited state of the movement, the transformations of which yield the equation of the problem, which call for Bessel functions. The general solution having been found, the boundary problem is considered, and is solved by series involving cylindrical functions. The simplest case thus having been dealt with, the author proceeds to generalizing this solution. Though fairly long, the calculations are neither particularly laborious nor are there any systematic difficulties. B. F. K.

CAPILLARITY 532.6

532.6 : 541.183.02

5277. Depths of the surface zone of a liquid. HENNIKER, J. C. *Rev. Mod. Phys.*, **21**, 322–41 (*April*, 1949).—A review of experimental data, tending to show that the surface zone is not a monolayer with unaltered liquid below, but a region in which orienta-tion extends to many molecular diameters. A bibliography of 174 papers is given. L. G. C.

532.61

5278. The surface tension of oils. HALPERN, A. *J. Phys. Coll. Chem.*, **53**, 895–7 (*June*, 1949).—Values for 9 fixed oils are given between 20–130°C. A.

532.61

5279. Surface tension of liquids. HARASIMA, A. *Proc. Phys.-Math. Soc. Japan*, **23**, 983–91 (1941) *In English.*—Surface tension of liquids was treated by the method of statistical mechanics. By assuming that molecules, which are on the first and second layers from the surface, share free volume while no sharing of free volume exists for inner molecules, the temp. dependence of surface tension was calculated and a formula very similar to that of Eötvös was derived. The formula is $\sigma = U - \frac{2 \cdot 10}{V^{2/3}} T$, where σ is the surface tension measured in dynes/cm, U the surface energy in ergs/cm and V the molal volume in cm. S. C. A. P.

532.61 : 535.32

5280. Surface tensions and refractive indices of the perfluoropentanes. ROHRBACK, G. H. AND CADY, G. H. *J. Amer. Chem. Soc.*, **71**, 1938–40 (*June*, 1949).

532.64

5281. Imaginary contact angles and the Jones–Ray effect. COOLIDGE, A. S. *J. Amer. Chem. Soc.*, **71**, 2153–67 (*June*, 1949).—Let 2 fluid phases be in equilibrium in contact with each other and with the plane surface of a rigid solid, and let the contact angle be calculated from the 3 surface tensions by means of

the usual relation. It is shown that if one of the fluids forms a wetting film of finite thickness upon the solid, and if the surfaces in which the tensions are supposed to act are defined as specified by Gibbs, then the value of the contact angle must be expected to be imaginary when the wetting fluid is under a lower pressure than the other, as in a capillary rise device. The Gibbsian surface of tension between the fluid phases is not defined at points within the molecular field of the wall, and if extrapolated into that region will not meet the wall. In order to describe the situation in terms of a fictitious tense membrane of zero thickness exactly at the Gibbsian surface, the membrane must be conceived as attached to the crest of a rigid dam closing the gap. The height of this dam, Δ, is $> \delta$, the thickness of the wetting film, instead of equal to it as assumed by Langmuir in explaining the Jones–Ray effect. The interplay of forces near phase boundaries and in wetting films is investigated in detail on the alternative bases of Laplace's model of an incompressible liquid and of the Debye–Hückel model of a dilute electrolytic solution. It is demonstrated that the surface tension may not for all purposes be assumed to act exactly in the Gibbsian surface of tension. Explicit formulae are found for the relation between Δ and δ. In the limiting case of high ζ-potentials, the Langmuir correction to the measured surface tension must be doubled. A.

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

5282. Atomic distribution of liquids. I. HARASIMA, A. AND OGURI, H. *Proc. Phys.-Math. Soc. Japan*, **25**, 425–31 (1943) *In English.*—Atomic distribution functions of liquid Hg and other monatomic liquids are interpreted by assuming that each atom oscillates around its equilibrium position independently of the others (harmonic oscillator model) and several constants concerning the structure of liquids are obtained. Effect of temp. change on the first maximum of the distribution function in the case of Hg can be interpreted by the model. S. C. A. P.

532.7

5283. Atomic distribution of liquids. II. HARASIMA, A. *Proc. Phys.-Math. Soc. Japan*, **25**, 534–9 (1943) *In English.*—Two methods to interpret atomic distribution function of liquids, one using a discontinuous box type model and the other using a harmonic oscillator model, are compared. It is shown that both models can be used equally well so long as comparison of the theoretical distribution functions with experiments is concerned. Parameters such as the free volume or the vibrational frequency of an atom are determined by comparing the theoretical curves with the experimental ones. S. C. A. P.

532.7 : 533.7

5284. Physics of liquids and gases. KAPPLER, E. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] 348 *pp.* (1948) *In German.*—The section on physics of liquids contains a discussion of work on: (1) the X-ray analysis of molecular structure; (2) dielectric and optical phenomena, includi dielectric relaxation; (3) interaction and associati phenomena (due to intermolecular forces), includi the structure of water and soap solutions; (4) syster with long-chain molecules; (5) anisotropic or crysta line liquids; (6) thermodynamics and statistic mechanics of liquids; (7) thermodynamics of liqu mixtures and solutions; (8) transport phenomen (9) heat conduction, viscosity and convectio (10) propagation of sound in liquids; (11) electric conduction in liquids and electrolytes. The secti on physics of gases has sections on: (1) therm dynamics and kinetic theory of gases, includi transport phenomena; (2) sound propagatio (3) dielectric and optical properties; (4) electrical d charges in gases. For the sections on unstea phenomena and colloid physics, see Abstr. 526 5756 (1949), respectively. L. S.

532.

5285. Metal–salt interactions at high temperature the solubilities of some alkaline earth metals in the halides. CUBICCIOTTI, D. D. AND THURMOND, C. I *J. Amer. Chem. Soc.*, **71**, 2149–53 (*June*, 1949).

532.7

5286. The primary solid solution of silver in al minium. RAYNOR, G. V. AND WAKEMAN, D. V *Phil. Mag.*, **40**, 404–16 (*April*, 1949).—The solubili curve for the primary solid solution was redetermine using pure materials. It is not smooth, but displa an abrupt change in direction near 49·4% of A at 526°C. It is shown that this change occurs at t same electron/atom ratio as the peak of the ($\alpha + \alpha$ miscibility gap in the Al–Zn system. The relatio between the Al–Zn and Al–Ag systems is describe in terms of free-energy curves, and the structure the Brillouin zone for Al. L. S.

MECHANICS OF GASES 533

533.

5287. Flow of adsorbed molecules. CARMAN, P. Letter in *Nature, Lond.*, **163**, 684–5 (*April* 30, 1949). Measurements were made of the flow of various gas through plugs of finely divided amorphous sili (max. particle size 0·05μ). Flow rates were measur at 22°C for H_2, air, CO_2 and CF_2Cl_2 all of which ga consistent values of the specific surface when t Brunauer–Emmett–Teller calculation was used. SC however, gave a flow rate $>$ expected. SO_2 appreciably adsorbed at 22°C and that this is responsib for the high flow rates is shown by measurements permeability of the plug for different pressu differences at 22°C and 0°C. One side of the plug at atmospheric pressure (660 mm Hg) and there is a extremely rapid increase in permeability at 0°C the pressure on the other side approaches 1 161 m the saturation vapour pressure of SO_2. It is suggeste that the concentration in the adsorbed film increas much more quickly than the pressure drop acro the plug. J.

533

5288. An electro-pneumatic vacuum valve. GREE G. W. Note in *J. Sci. Instrum. Phys. Ind.*, **26**, 2

June, 1949).—The valve, consisting of sylphon bellows and rubber disc seal, is shown diagrammatically. By isolating the rotary backing pump from the vacuum system, it protects the system from mechanical drive failure of the pump due to mains supply interruption or belt breakage, and prevents oil being forced into the backing line. S. W.

533.5

5289. Large straight through vacuum valve for Van de Graaff generators. JENNINGS, B. *Rev. Sci. Instrum.*, **20**, 366–7 (*May*, 1949).—This must be very light and be easily and quickly closed. A suitable valve, operated by a 3-bar lever structure, is described, with drawing. Action is easy and could be made automatic by motor or weight drive. The valve has been tested both with vacuum above and below the heat and no leak detected in either direction. G. W.

533.5 : 531.788 : 534.232

5290. New vacuum gauge. JOHNSON, C. F. *Rev. Sci. Instrum.*, **20**, 364 (*May*, 1949).—Observations were made on variation of motional impedance of a magnetostrictive transducer. Relevant theory of transducer, and instruments used, are described, with diagram of bridge arrangement. At pressures < 10 mm Hg, maximum bridge unbalance $\simeq 80$ mV. A transducer of specified improved design should be usable as fundamental vacuum gauge. G. W.

533.5 : 531.788.7 : 621.316.721.076.7

5291. Ionization gauge pressure switch. MILNER, C. J. AND WATT, I. M. Note in *J. Sci. Instrum. Phys. Ind.*, **26**, 159 (*May*, 1949).—A description is given, with detailed circuit diagrams and list of components, of an electronic switching system for the protection of ionization gauge filaments against excessive increase of pressure, and suitable for incorporation in the control unit of King [Abstr. 1528 (1946)]. S. W.

533.5 : 542.7

5292. Use of gas traps in barometers, laboratory mercury lamps, etc. HARRINGTON, E. L. *Rev. Sci. Instrum.*, **20**, 368–9 (*May*, 1949).—2 constructions of a trap to retain residual gases, depending for its action on the reluctance of Hg to enter a capillary, are described, with diagrams. Above the Hg, the space to be freed of gas is connected by a vertically bent capillary to a bulb. Raising the Hg level compresses the gas through the capillary into the bulb, until Hg just enters capillary. A short Hg seal remains in the capillary when the level is lowered. The article is mainly devoted to details of design with several modifications, and application to a laboratory Hg lamp which was thereby improved in several respects. G. W.

533.6 : 532.5

Mathematical foundations of fluid mechanics. *See Abstr.* 5272

533.6.011

5293. A torsion balance for measuring forces in low density gas flows. ESTERMANN, I. AND KANE, E. D. *J. Appl. Phys.*, **20**, 608–10 (*June*, 1949).—A torsion balance, designed to measure the force on a flat plate (or other simple geometry) in a low density gas flow, is described. The balance has been used with two interchangeable torsion member sizes, with diameters of 0·00064 in and 0·00090 in, which measured forces up to a maximum of 0·6 mg and 2·4 mg, respectively. Calibrations (obtained in still air using weights) were reproducible within $\pm$ 0·005 mg and $\pm$ 0·04 mg for the two sizes. Data obtained for a flat plate in a gas stream under large molecular mean free path conditions are presented. A.

533.6.011 : 612.2

Physical instruments for the biologist. *See Abstr.* 5826

533.6.011.6 : 536.551

5294. Measurement of stagnation temperature in high-speed gas streams. BRUN, E. AND PLAN, M. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 8) 231–7 (1949) *In French.*—A thermocouple in a confined space communicating with the gas stream by an orifice facing upstream does not, as might at first be thought, measure the stagnation temperature in the stream; under these conditions convection and radiation equalize the temperature of the thermocouple with that of the surrounding walls. More accurate values can be obtained if gas is allowed to flow around the thermocouple; an optimum flow-velocity exists, at which convectional effects are greatly reduced but the stream temperature does not differ much from the stagnation temperature. This optimum velocity was derived theoretically. A stagnation thermometer consisting of a thermocouple 0·6 mm dia. contained in a tube 5 mm int. dia. having an orifice choke 2 mm dia. at its downstream end was tested in a high-speed wind-tunnel. For main-stream Mach numbers between 0·5 and 2·0 the device measures stagnation temperatures to an accuracy of 0·2–0·3°C. It is not sensitive to the angle of incidence of the tube to the stream, 10° incidence introducing no appreciable error. A. SCH.

533.6.08 : 621.317.39

5295. Some improvements in the hot-wire anemometry. KOVÁSZNAY, L. I. G. *Hungar. Acta Phys.*, **1** (*No.* 3) 25–51 (1948) *In English.*—Dynamical characteristics of the hot wire are introduced into the theory taking into consideration the reaction of heating current fluctuation upon the hot wire caused by the resistance fluctuation of the wire itself. Loss of sensitivity and variation of time constant depend on the design of heating circuit. Square current waves are applied to the hot wire for the study of compensation performance and measurement of time constant. A compensated amplifier based upon a new working principle is described. The amplifier has two separate stages in parallel, both of them satisfying simple requirements for frequency characteristics. The compensation is controlled by varying the amplification ratio of the two stages by means of a simple potentiometer. A.

MOLECULAR THEORY OF GASES 533.7

533.7 : 532.7

Physics of liquids and gases. *See Abstr.* 5284

533.7

5296. Transport properties of multicomponent gas mixtures. CURTISS, C. F. AND HIRSCHFELDER, J. O.

J. Chem. Phys., **17**, 550–5 (*June*, 1949).—Equations are derived for the viscosity, ordinary (pressure) diffusion, and thermal diffusion of multicomponent mixtures of gases. The ordinary diffusion velocities are expressed in terms of the usual diffusion coefficients for binary mixtures. The analysis is an extension of the work of Chapman and Cowling. It is shown that the Chapman–Cowling and Enskog procedure can be justified on the basis of a variational principle. This variational principle should be generally applicable to a large class of problems. A.

533.7 : 536.71 : 539.132

5297. Forces between ammonia molecules and the second virial coefficient for ammonia. MYERS, V. Letter in *Phys. Rev.*, **75**, 1620–1 (*May* 15, 1949).—The second virial coefficient of NH_3 is calculated, including the quadrupole moment terms as well as the dipole interaction terms. D. H. W.

533.723

5298. Brownian motion in a plasto-elastic medium. OSIDA, I. *Proc. Phys.-Math. Soc. Japan*, **24**, 599–601 (1942) *In English.*—The motion of a particle in a medium, which has plasticity as well as elasticity, is treated, and a formula giving the mean square distance as a function of time is derived. S. C. A. P.

533.75

5299. Equation of state of gases and the critical state. KIHARA, T. *J. Phys.-Math. Soc. Japan*, **17**, 11–15 (1943).—With a simplified potential function the third virial coeff. has been integrated and constants determined from the second virial coeff. have been used. The results are in good agreement with experiments. The quantities relating to the critical state have been calculated by the approximate formula which contains up to the third virial, with reasonable results. S. C. A. P.

533.75

5300. Quantum mechanical correction to the intermolecular potential of gas. KIHARA, T. *J. Phys.-Math. Soc. Japan*, **16**, 140–5 (1942).—Quantum mechanical correction must be applied to the intermolecular potential obtained from the equation of state or viscosity coeff. of gas. Light and small molecules, which require quantum mechanical correction, generally resemble the hard sphere model. Taking this fact into consideration, approx. formulae of 2nd virial coeff. and viscosity coeff. were obtained quantum mechanically. These can be expressed as the classical mechanical formula multiplied by a factor, which is quantum mechanical correction to a rigid sphere molecule. By these formulae, a simple relation between the intermolecular potential determined classically and that corrected quantum mechanically was derived. The numerical values for a few molecules were calculated. Finally quantum mechanical effect on the thermal diffusion of isotopic gas molecules was considered. It was discussed that thermal diffusion constant differs from the classical mechanical value according to the kind of statistics. S. C. A. P.

533.75 : 536.71

5301. Viscosity and second virial coefficients of gaseous hydrogen at low temperatures. MIYAKO, R. *Proc. Phys.-Math. Soc. Japan*, **24**, 852–63 (1942) *In English.*—The viscosity and second virial coefficient of gaseous H were calculated in the temp. ran 15–25°K by taking account of the quantum-mechanic effects. They were also given as functions of t relative concentration of the ortho- and para-hydroge It is concluded that the potential functions deriv from Lennard-Jones and Boer–Michels are not qu satisfactory in the low temp. range. S. C. A.

VIBRATIONS . ACOUSTICS 534

534.

5302. Velocity of sound in liquid hydrogen. V ITTERBEEK, A. AND VERHAEGEN, L. Letter in *Natu Lond.*, **163**, 399 (*March* 12, 1949).—This was measur at 523 kc/s between 14·8 and 21·0°K. The observ drift with time, and the fact that the velocity at 17 is > that found by Galt using the pulse techniq [Abstr. 3207 (1948)] is ascribed to a gradual tran formation into para-hydrogen. H.

534.

5303. Hypersonic velocity in acetone at low ter peratures. RANK, D. H., SHULL, E. R. AND AXFOR D. W. E. Letter in *Nature, Lond.*, **164**, 67–8 (*July* 1949).—Sound velocity at 5×10^8 c/s (hyperson velocity) is close to the ultrasonic velocity at bo 30°c and −78°c, in acetone. [See also Abstr. 18 (1948)]. D. H.

534.22 : 534.321

5304. Absorption and velocity of ultra-sonic wav in some highly viscous liquids and amorphous so bodies. MIKHAILOV, I. G. AND GUREVICH, S. *J. Exp. Theor. Phys., USSR*, **19**, 193–201 (*Marc* 1949) *In Russian.*—Results are presented of measur ments of the absorption of ultrasonic waves in fus and solid rosin within the temperature interval fro 40 to 145°c, and also of their absorption and veloci in polymethyl methacrylate. In the frequency ran investigated and at high viscosities the coefficient absorption in rosin decreases with increasing vi cosity, as follows from relaxation theory. T coefficient of absorption in highly viscous rosin a in methyl methacrylate approx. $\propto$ (frequency) which does not correspond to the relaxation theory its simplest form. In methyl methacrylate th frequency relation of the absorption is not connect with dispersion. B. F.

534.22 : 541.6

5305. Propagation of audiofrequency sound in hig polymers. WITTE, R. S., MROWCA, B. A. AND GUT E. *J. Appl. Phys.*, **20**, 481–5 (*June*, 1949).—Veloci and attenuation measurements were made in th strips of rubber from 0·5 to 5 kc/s and from −5 to 90°c to obtain the dynamic viscoelastic constan of butyl and GR-S gum stocks. Above room tem velocity and attenuation are higher in butyl gu than in GR-S. In all cases, the velocity increas with decreasing temp. and increasing frequenc The attenuation shows a peak with temp. For but the peaks are broad and occur at higher temps. tha for GR-S. For both stocks an increase in frequenc gives peaks which are higher and sharper, and shifte

o higher temps. In some instances, there are indications of peaks in the attenuation *v.* frequency at frequencies beyond the range of measurement. The behaviour of the dynamic modulus in the temp. and frequency range studied is similar to that of the velocity. These results combined with low temp. static measurements and very low frequency dynamic measurements indicate a U-shaped modulus-temp. curve whose minimum broadens and shifts to higher temps. with increasing frequency. This may be explained by a generalization of the kinetic theory of rubber elasticity, taking into account intra- and intermolecular forces, and considering time effects. A.

534.222.2

5306. Wave propagation in anisotropic continua and corresponding principal directions. PASTORI, M. *Nuovo Cim.*, **6** (*No.* 3) 187–93 (*May* 7, 1949) *In Italian.*—At any point within an isotropic medium in which shock waves propagate there exist at least 3 directions such that, for the wave surfaces to which these directions are normal, the sum of the squares of the 3 velocities of propagation is stationary. L. P.

534.232 : 531.788 : 533.5

Transducer as vacuum gauge. *See Abstr.* 5290

534.3

5307. Why do two violins always make more noise than one alone? MOLES, A. *J. Phys. Radium*, **10**, 194–9 (*June*, 1949) *In French.*—The theory of interference suggests that when two violins play in unison there is a probability of 0·5 that the resultant sound will be less intense than that of either of its components. Experience shows that this is not the case, and various explanations of this fact have been offered, in particular the hypothesis of sudden erratic variations in the relative phase of the two instruments. The author's experiments indicate, however, by actual recording of the vibrations of the two violins, that the result is attributable to the numerous erratic fluctuations of frequency around the nominal "unison" value. An estimate has been made of the order of magnitude and the causes of these fluctuations of frequency. A. B. W.

534.321.9

5308. Electric-field modulation of ultrasonic signals in liquids. NOLLE, A. W. *J. Appl. Phys.*, **20**, 589–92 (*June*, 1949).—An experiment is performed to determine whether the presence of a periodic transverse electric field produces modulation, either of amplitude or of phase, of a continuous progressive ultrasonic wave train passing through the liquid. One object of the experiment is to ascertain whether the application of an electric field to a polar liquid influences either the compressibility or the viscosity of the liquid through molecular orientation. The results of a related investigation in which an electric field was applied in the direction of wave travel, published in 1945 by Barone and Giacomini [see Abstr. 2401 (1948)], were inconclusive. The present experiments reveal phase modulation in a number of conducting liquids. This is explained as a thermal effect involving the temp. dependence of velocity of sound. No evidence is found of phase modulation resulting from dipole orientation in non-conducting polar liquids. Amplitude modulation, which would result from change of attenuation, is not found in any liquid. A variety of organic liquids is investigated. Limits of sensitivity of the apparatus are given. A.

534.321.9

5309. Dispersibility of coal in a supersonic field. BERKOWITZ, N. Letter in *Nature, Lond.*, **163**, 809–10 (*May* 21, 1949).—With some coals, the portion insoluble in pyridine becomes partially dissolved or dispersed in this liquid when exposed to waves of 25 kc/s for 15 min. When the extract thus formed was recovered, it formed a black, free-running solid only slightly soluble in boiling pyridine and had an elementary composition similar to that of the original. Various explanations are considered, and it is concluded that these coals simulate thixotropic substances in that their micellar structure can be disturbed by a sufficiently high energy input, such as the ultrasonic vibrations, but they become largely reconstituted when the disturbance is removed. A. C. W.

534.321.9

5310. Ultrasonic lenses of plastic materials. SETTE, D. *Nuovo Cim.*, **6**, 135–47 (*March*, 1949) *In Italian.*—Experiments on the concentration of ultrasonic beams in liquids by Plexiglass lenses are described. A solid-liquid doublet lens with a mica window can be used in liquids that attack the material. The transmission loss in the plastic is $\gg$ than in metals. [See Abstr. 726 (1946)]. T. S. E. T.

534.321.9 : 539.163

5311. Radioactive emanating power and ultrasonic treatment. MÅRTENSSON, M. AND LAMM, O. Letter in *Nature, Lond.*, **136**, 447 (*March* 19, 1949).—An investigation into the effect of ultrasonic radiation on gels has been made using the emanation method. Al_2O_3 was precipitated in the presence of Ra–Th. Ultrasonic treatment with a 1 500 kc/s source increased the emanating power between 24 and 33% depending on the power of the generator. It is concluded that the results indicate a break-up of the agglomerates of the gel by the sound waves. An alternative explanation is that the ultra-sound may affect the amount of H_2O absorbed by the gel. G. O. B.

534.321.9 : 541.64

5312. Transition temperatures of methyl methacrylate polymers at ultrasonic frequencies. PROTZMAN, T. F. *J. Appl. Phys.*, **20**, 627–30 (*June*, 1949).—The velocity of sound in methyl methacrylate polymers (Plexiglas) has been measured at temps. from 24° to 90°C, and frequencies from 3 to 11 Mc/s. Optical diffraction methods were used to determine the sound velocity within a max. error of 1%. This low experimental error made possible a detailed study of the sound velocity-temp. relationships. A previously unreported transition of a new type has been found. The sound velocity decreases linearly with increasing temp., with an abrupt increase of slope occurring when a transition temp. is reached. The transition temp. is found to decrease linearly with frequency, falling from 64°C at 3 Mc/s to 49°C at 11 Mc/s. The observed transitions apparently are not manifestations of elastic relaxational effects and are tentatively attributed to the excitation of some mode of molecular motion, for example, molecular vibrations. A.

534.321.9 : 541.64

5313. Propagation of ultrasonic bulk waves in high polymers. IVEY, D. G., MROWCA, B. A. AND GUTH, E.

J. Appl. Phys., **20**, 486–92 (*June*, 1949).—The propagation of supersonic waves in bulk rubbers has been studied from 40 kc/s to 10 Mc/s and from −60°c to 60°c. The wave velocity was found to increase with decreasing temp., levelling off both at high and low temps., and was found to increase slightly with frequency. Peaks in attenuation as a function of either temp. or frequency were observed, the peaks occurring at lower temps. for lower frequencies. The peaks for butyl, a high loss rubber, are broader and higher than those for GR-S and Hevea, which are lower loss rubbers. The results are in qualitative agreement with data obtained by strip methods at audiofrequencies. However, for bulk waves the real and imaginary parts of two elastic constants, the bulk and shear moduli, determine wave velocity and attenuation; hence, independent measurements of shear wave properties are necessary to evaluate these constants. A 3-constant theory is discussed, assuming a shear viscosity only, so that an effective modulus $K + 4\mu/3$ is obtained, where K and μ are the bulk and shear moduli. Relaxation times of the order 10^{-6} to 10^{-8} sec are indicated. Approx. values of the dynamic Young's modulus are obtained from the effective modulus by assuming that the high-frequency dispersion is due to the appearance of a "crystalline" shear elasticity. These results are correlated with low frequency data, and the dynamic Young's modulus and the loss factor are plotted. The loss factor exhibits a maximum in the dispersion region. Results are plotted in the range from 1 c/s to 10^7 c/s, which covers a wider range of frequency than earlier investigations. The necessary distribution of relaxation times is discussed. A.

534.321.9 : 542.48

The effect of sound waves on fractional distillation. *See Abstr.* 5769

534.321.9 : 578

5314. Contribution to the technique of research into the biological effects of ultrasonics. GIACOMINI, A. *Nuovo Cim.*, **6**, 39–49 (*Jan.*, 1949) *In Italian.*—The author criticizes earlier apparatus on the grounds that the ultrasonic energy cannot be computed, the unknown effects of reflected rays, and the resulting uncontrolled heating of the suspension fluid. A new apparatus is described which meets these criticisms. A supersonic beam is transmitted linearly through the test tube, provided at entrance and exit with windows of known and suitable acoustic properties; the beam being propagated similarly through a liquid of appropriate properties. Control is optical. W. A. R.

OPTICS . RADIATION . SPECTRA 535

535.222

5315. Velocity of light and measurement of distances by high-frequency light signalling. BERGSTRAND, E. Letter in *Nature, Lond.*, **163**, 338 (*Feb.* 26, 1949).—A modern version of a device for the measurement of the velocity of light by means of Fizeau's principle is described. The light source is modulated by crystal-controlled 8·3 Mc/s oscillator, reflected by a distant mirror and received by a photocell. The h.t. of t photocell is supplied from the same oscillat Owing to the delay caused by the light transmissi the moments of high sensitivity of the cell are m or less timed to the incoming blinks. The photocurre thus passes through successive zeros for a change distance between source and mirror of 9 m. Maki the necessary corrections for atmospheric conditio a provisional value for the velocity of light *in vac* of 299 796 ± 2 km per sec was obtained. Mo accurate measurements will be made. H. M

535.23.

5316. Effect of temperature on the steady-sta sensitivity of vacuum radiation detectors. AMDUR, AND BROWN, N. L. *Rev. Sci. Instrum.*, **20**, 435– (*June*, 1949).—The steady-state sensitivities of tw vacuum radiation thermocouples of very differe design and a vacuum compensated bolometer ha been measured at 298°, 205° and 96°K, and the effe of temp. has been found to vary widely for the detectors. The observed results have been accounte for quantitatively in terms of theoretical sensitivi relations which are based on exact heat flow theo and take into account the specific structural chara teristics of the detectors. The treatment is sufficient general to permit the prediction of steady-sta sensitivities as a function of temperature for a vacuum radiation thermocouple or bolometer who structural characteristics are known.

535.24 : 535.4

5317. Photometric study of diffraction at a distance application to visual photometers without a diffusi surface. TERRIEN, J. AND DESVIGNES, F. *J. Phy Radium*, **10**, 6–11 (*Jan.*, 1949) *In French.*—In photo meters using the Maxwellian view, if the incide beam is very narrow, the dividing line in the photo meter field is dark and may have an appreciabl thickness. This is due to diffraction at the edge o e.g. the biprism. The authors treat the proble mathematically and show that the effect disappears the entrance slit is sufficiently large. Its image a the exit pupil should be at least 15 mm wide, i.e. i the direction perpendicular to the diffracting edge. J. W. T. W

535.31

5318. A theorem in geometrical optics. MARU YAMA, S. *Proc. Phys.-Math. Soc. Japan.*, **23**, 1010–1 (1941) *In English.*—In optical design, the method o combining two systems which have aberrations i themselves, to make a perfect system, is used fre quently. The conditions the two-component system must satisfy in order to make a perfect system ar studied by use of Seidel's aberration formulae. Th conditions that the total system is free from 5 aberra tions are obtained. S. C. A. P

535.31

5319. The symmetrical optical systems. MARU YAMA, S. *Proc. Phys.-Math. Soc. Japan*, **23**, 799–80 (1941) *In English.*—In symmetrical optical system the importance of the distance between the two lense is discussed by means of Seidel's aberration formulae The position of the coma-free diaphragm and th correction of distortion are also discussed. S. C. A. P

535.317

5320. On the theory of Maksutov's catadioptric system. DURÁN, A. AND MARTIN-TESORERO, A. *An. Real Soc. Esp. Fis. y Quim.*, **44 (A)** 25–52 (*Jan.–Feb.*, 1948) *In Spanish.*

535.317.1

5321. On a general theory of the image in optical systems having a plane of symmetry. DI JORIO, M. *Nuovo Cim.*, **6**, 57–61 (*Jan.*, 1949) *In Italian.*

535.317.5

5322. On the tolerance for the wave aberration of optical systems. SANCHEZ DEL RIO, C. *An. Real Soc. Esp. Fis. y Quim.*, **44 (A)** 175–87 (*March–April*, 1948) *In Spanish.*—Spherical aberration only is considered. Formulae are deduced giving, in various cases, the max. wave aberration allowable in order that the circle of least confusion should not be > the diffraction disc. L. P.

535.32 : 532.61

Surface tensions and refractive indices of the perfluoropentanes. *See Abstr.* 5280

535.33.07

5323. Illumination of the slits of a spectrograph with an extended non-absorbing source of light. SLYUSAREV, G. G. AND CHULANOVSKY, V. M. *J. Tech. Phys., USSR*, **18** (*No.* 5) 665–72 (*May*, 1948) *In Russian.*—Theoretical details of the most advantageous optical systems are discussed. D. H. W.

535.33.072–15

5324. Percent transmission computer for infra-red spectra. ZERWEKH, C. E., JR. *Rev. Sci. Instrum.*, **20**, 371–2 (*May*, 1949).—By following absorption and background traces with hand pointers, potentiometer resistances are set so that % absorption is automatically recorded on a second recorder chart. D. H. W.

535.333

5325. Predissociation in the second positive nitrogen group. HORI, T. AND ENDO, Y. *Proc. Phys.-Math. Soc. Japan*, **23**, 834–42 (1941).—The band spectra of gases such as N, O, H, air, CO_2 were studied under high pressure (about 1 atm.) with the method of torch discharge. New bands due to N_2^+ and N_2 molecules were observed. Of the results obtained, predissociation in the second positive band of N is reported. The pressure effect was observed closely, and new predissociations discovered. S. C. A. P.

535.333

5326. Vibration spectra of *cis* and *trans* $C_2H_2Cl_2$ and $C_2D_2Cl_2$. BERNSTEIN, H. J. AND RAMSAY, D. A. *J. Chem. Phys.*, **17**, 556–65 (*June*, 1949).—The infra-red spectra of gaseous and liquid *cis* and *trans* $C_2H_2Cl_2$ and $C_2D_2Cl_2$ have been obtained in the region 3 500 to 400 cm^{-1}. The fine structure of a $\perp$ band in *trans* $C_2H_2Cl_2$ was also resolved and the least moment of inertia obtained. An assignment of all the fundamentals for the 4 molecules has been made. Calculations of potential functions and of the equilibrium constants for the reaction *cis* $\rightleftharpoons$ *trans* support the assignment. A.

535.333

5327. Ultraviolet bands of the zinc iodide molecule. III. RAMASASTRY, C. *Indian J. Phys.*, **23**, 35–49 (*Jan.*, 1949).—A new group of bands (designated as system D_1) of the ZnI molecule, lying in the region $\lambda 2990$–$\lambda 2700$, is recorded and analysed; isotopic component heads due to $Zn^{64}I^{127}$, $Zn^{66}I^{127}$ and $Zn^{68}I^{127}$ are well resolved and appear conspicuously. The vibrational numbering of the various bands is derived from considerations of the observed isotope shifts. The constants calculated for the D_1 system are:

$$\omega'_e = 80{\cdot}0 \qquad x'_e\omega'_e = 1{\cdot}25$$
$$\nu_e = 39\,911{\cdot}4 \qquad \omega''_e = 220{\cdot}1 \qquad x''_e\omega''_e = 0{\cdot}825$$

Predissociation is observed in the upper state at the vibrational level $v' = 2$. Six characteristic continua, observed in the emission spectrum of ZnI, are also reported for the first time. A discussion is presented giving a correlation of the electronic configuration and molecular states of the zinc iodide molecule with the observed band systems. A.

535.337 : 537.228.5

5328. The lower limit of the linear Stark effect in hydrogen. STEUBING, W. *Z. Phys.*, **125** (*Nos* 7–10) 423–6 (1949) *In German.*—No first-order Stark effect is observed for H_β or H_γ at field-strengths less than about 2 000V/cm, contrary to theory. R. F. B.

535.338

5329. Emission of the molecular spectrum of nitrogen in a helium atmosphere. HERMAN, R. AND HERMAN, L. *J. Phys. Radium*, **10**, 132–6 (*April*, 1949) *In French.*—A study was made of the emission (including phosphorescence) from N_2 diluted with He. With a low partial pressure of N_2 there was observed in phosphorescence an N_2^+ spectrum composed almost exclusively of the first negative system and resembling the auroral spectrum observed at low latitudes. A number of intensity modifications were also observed and are discussed. A. H.

535.338.3

5330. The relative intensity of doublet spectra. KAR, K. C. AND SENGUPTA, S. *Indian J. Phys.*, **23**, 19–34 (*Jan.*, 1949).—A general wave statistical approximation method is developed for calculating the spin and relativity corrections of eigen-energy. The method has also been extended to calculate the relative intensities of simple and compound doublet spectra. The intensities thus calculated are in agreement with those obtained from the application of Burger and Dorgelo's empirical rule. A.

535.338.333

5331. Isotope shift in the helium spectrum. FRED, M., TOMKINS, F. S. AND BRODY, J. K. Letter in *Phys. Rev.*, **75**, 1772–3 (*June* 1, 1949).—Shifts for lines and terms from visible and near u.v. spectrum of He^3 and He^4 are tabulated. Calculated shifts, using formula of Hughes and Eckart, are valid for *P* terms, but for *S* and *D* terms there is a difference between calculated and observed shifts $\propto 1/T^{\frac{1}{2}}$ where *T* is term value. A. G. G.

535.338.4

5332. New electronic band-systems of diatomic boron compounds (BF, BO and BH). CHRÉTIEN, M. AND MIESCHER, E. Letter in *Nature, Lond.*, **163**, 996–7 (*June* 25, 1949).—Preliminary accounts of new systems lying in the region 1 400–2 100 Å are given. R. F. B.

535.338.5

5333. Runge bands of O_2 in flame spectra. WOLFHARD, H. G. AND GAYDON, A. G. Letter in *Nature, Lond.*, **164,** 22–3 (*July* 2, 1949).—The bands occur in emission from diffusion flames of CO with O_2, and H_2 with O_2, but not in CO–air flames. The ordinary CO flame bands are not identical with the Runge bands; they occur in a different part of the flame.

A. G. G.

535.343

5334. The absorption spectra of transuranic salts in crystals. FREED, S. AND LEITZ, F. J., JR. *J. Chem. Phys.*, **17,** 540–1 (*June*, 1949).

535.343–15

5335. [A review of] some results obtained from 1940 to 1946 in studies of infra-red spectra at the Sorbonne. LECOMTE, J. *Rev. Opt.* (*Théor. Instrum.*) **28,** 353–73 (*June*, 1949) *In French.*

535.343.1

5336. The absorption spectrum of atomic sodium. THACKERAY, E. R. *Phys. Rev.*, **75,** 1840–4 (*June* 15, 1949).—Using a long optical path attained by the method of Kratz and Mack, the wavelengths of the principal series of Na in absorption have been measured to $n = 73$, and observed to $n = 79$. The members to $n = 9$ have been resolved. The series limit has been computed to be 41 449·65 ± 0·02 cm^{-1} from the c.g. or 41 449·69 ± 0·02 cm^{-1} from the lower hyperfine structure component, of the $3s^2S_{1/2}$ term. Forbidden $3s^2S_{1/2} - nd^2D_{3/2,\ 5/2}$ were found up to $n = 13$. A critically compiled table to all known levels, including $np^2P_{1/2,\ 3/2}$ to $n = 73$ and $nd^2D_{3/2,\ 5/2}$ to $n = 13$, is given. The pressure shift from a foreign gas is less than reported by some earlier observers.

A.

535.343.1

5337. The principal series of potassium, rubidium, and cesium in absorption. KRATZ, H. R. *Phys. Rev.*, **75,** 1844–50 (*June* 15, 1949).—The doublet fine-structure has been resolved out to 17*p* in K, to 26*p* in Rb, and to 21*p* in Cs; the doublet fine-structure niterval varies in each spectrum inversely as the cube of the effective principal quantum number. In Cs, the doublet intensity ratio, instead of having a max., increases with increasing n as far as it can be followed. Higher series members, with their doublet fine-structure unresolved, have been measured to 79*p* in K, to 77*p* in Rb, and to 73*p* in Cs. The series limits, calculated from the lowest hyperfine structure levels, are: $K^{39}\ 4s^2S_{\frac{1}{2}}{}^1 - \infty = 35\,009{\cdot}83\ cm^{-1}$; $Rb^{85}\ \ 5s^2S_{\frac{1}{2}}{}^2 - \infty = 33\,691{\cdot}02\ cm^{-1}$; Cs $6s^2S_{\frac{1}{2}}{}^3 = 31\,406{\cdot}71\ cm^{-1}$. The hyperfine structure of the ground level $6s^2S_{\frac{1}{2}}$ has been resolved in each member of the principal series of Cs.

A.

535.343.2 : 536.48

5338. Infra-red absorption spectra of some polymers at liquid-helium temperatures. KING, G. W., HAINER, R. M. AND MCMAHON, H. O. *J. Appl. Phys.*, **20,** 559–63 (*June*, 1949).—Infrared absorption spectra of polythene, rubber, polystyrene and polyvinyl chloride have been obtained at 4°K, in the rocksalt region, in a specially designed transmission cell containing liquid He. No unusual changes occur on cooling which considerably alter the absorption. Some sharpening and improvement in resolution occurs, but the widths of most bands in polymers rema wide. In polythene one component of the doubl at 720 cm^{-1} becomes very sharp (possibly even le than the experimental value of the slit width, 1 cm^{-1} Its companion remains broad, about 4 cm^{-1}. T two components are interpreted as CH_2 wagging *trans-* and *cis-*configurations of the hydrocarb chain.

535.343.2–15 : 539.1

The infra-red spectrum of polythene. *See Abst* 5603

535.343

5339. Spectra of iodine and bromine solution BAYLISS, N. S. Letter in *Nature, Lond.*, **163,** 764– (*May* 14, 1949).—The u.v. band of Br in benzene ha $\varepsilon_{max} = 6\,800$ at 2 930 Å and an oscillator strengt $f = 0{\cdot}18$, whilst the corresponding I band ha $\varepsilon_{max} = 9\,200$ at 2 980 Å with $f = 0{\cdot}23$. These band are very strong and of the order of magnitude of th (N, V) transitions in gaseous Br and I in the vacuu u.v. near 1 600–1 700 Å. Such displacement towar the red ($\Delta\nu$) would be largely accounted for by th relationship $\Delta\nu = (4e^2D/\alpha hc)(1 - 1/n^2)$, where α the polarizability of solute molecules in a solvent refractive index n, and D is the dipole strength the absorption band. An equation is given cor necting D with ε_{max} and the "half-width" of th absorption band. It is considered that the influenc of solvation is < has been suggested previously.

W. R. A

535.343.3/.4 : 539.13

5340. Absorption spectrum of benzene. I. Com parison of spectra of benzene vapour and liquid betwee 3 and 15 μ. BARCHEWITZ, P. *J. Phys. Radium*, **1** 1–5 (*Jan.*, 1949) *In French.*—Comparison of th respective spectra shows that the symmetry of th benzene molecule is modified on passage from vapou to liquid state. The bands observed between 3 an 15 μ are identified.

C. B. A

535.343.3

5341. The visible absorption spectrum of bromin in solution. BAYLISS, N. S., COLE, A. R. H. AN GREEN, B. G. *Aust. J. Sci. Res. A*, **1,** 472–9 (*Dec* 1948).—The visible absorption spectrum of Br wa measured in *n*-hexane (a normal solvent) and i concentrated sulphuric acid (at room temp. and a −70°C), phosphoric acid, and ethanol (at −70°C) a associated solvents. The absorption continuum a 4 150 Å in the gas is displaced slightly to the red i *n*-hexane although other normal solvents may displac it to the violet. The displacement to the violet i greater in associated solvents, ranging from 650 cm in sulphuric acid to over 2 000 cm^{-1} in ethanol. Th displacement in sulphuric acid glass at −70°C i nearly double the value at 18°C. The displacement in associated solvents are explained in terms of th effect of the semi-rigid cage of solvent molecule surrounding each Br molecule, and the assumptio of "solvates" is unnecessary and undesirable. Th spectra in solution are between 40 and 70% mor intense than in the gas, about double the increase tha would be predicted by Chako's treatment of the effec of Lorentz–Lorenz forces. The differences in th shape and ε_{max} between solutions in sulphuric acid a 18°C and at −70°C are due to the different statistica

distribution of Br molecules between the vibrational energy levels. A.

535.343.4 : 535.338.334

5342. The pressure-dependence of the total absorption in infra-red band spectra. MATOSSI, F. AND RAUSCHER, E. *Z. Phys.*, **125** (*Nos* 7–10) 418–22 (1949) *In German.*—The absorption by the 6 μ H_2O band at total pressures of 0·5 to 1 atm. follows approximately a $p^{\frac{1}{2}}$ law (taking the line-width to be 0·52 cm^{-1}), rather than the $p^{\frac{1}{2}}$ law expected on simple grounds. R. F. B.

535.343.4–14

5343. Microwave absorption of some organic vapors. BAK, B., KNUDSEN, E. S. AND MADSEN, E. Letter in *Phys. Rev.*, **75,** 1622–3 (*May* 15, 1949).—Preliminary values of line frequencies between 22 600 and 25 700 Mc/s are given for brombenzene, ethyl alcohol, acetone, nitromethane and methyl alcohol. D. H. W.

535.343.4–14

5344. Microwave spectrum of formaldehyde. BRAGG, J. K. AND SHARBAUGH, A. H. Letter in *Phys. Rev.*, **75,** 1774–5 (*June* 1, 1949).—Four lines between 9 000 and 27 000 Mc/s are identified on a semi-rigid rotor approximation. The Stark effect gives a dipole moment of 2·17 ± 0·02 D. D. H. W.

535.343.4–14 : 539.152.2

Fine structure of OCS^{33} microwave spectrum. *See Abstr.* 4116

535.343.4–15 : 539.132

5345. Infra-red absorption of oxygen and nitrogen induced by intermolecular forces. CRAWFORD, M. F., WELSH, H. L. AND LOCKE, J. L. Letter in *Phys. Rev.*, **75,** 1607 (*May* 15, 1949).—The fundamental vibrational bands at 1 556 and 2 331 cm^{-1} in O_2 and N_2 respectively were observed in infrared absorption at pressures > 20 atmos. For pure gases, the intensity $\propto$ (pressure)^2, which indicates distortion of the molecules, leading to dipole absorption as opposed to quadrupole absorption. *O*, *Q* and *S* branches are observed so that the selection rule is $\Delta J = 0, \pm 2$. D. H. W.

535.37

5346. The structure of molecules and fluorescence. ZELINSKI, V. V. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13,** 43–8 (*Jan.–Feb.*, 1949) *In Russian.*—A general discussion of the fluorescence of substituted benzene, in which resonance forms with positive charges on the ring reduce fluorescence and those with negative charges increase it. The action of "diminofluors" and "auxofluors" are thus explained and apparent anomalies when more than one substituent is present are removed. D. H. W.

535.37

5347. On the flash mechanism of SrS-phosphors activated by rare-earth activators, and the interaction between the activators. ANTONOV-ROMANOVSKIĬ, V. V., LEVSHIN, V. L., MORGENSHTERN, Z. L. AND TRAPEZNIKOVA, Z. A. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13,** 75–90 (*Jan.–Feb.*, 1949) *In Russian.*—It has been found that, in the case of phosphors possessing two rare-earth activators, certain chemical forces cause the latter to be arranged side by side so as to form a complex centre of luminescence. The analysis of experimental data (temperature stimulation of excited phosphors, luminescence spectra, and spectral sensitivity of the flashing-up) shows that luminescence (and long-wave absorption) centres brought about by an activator may at the same time serve as centres of accumulation of electrons and centres of absorption of the stimulating light. The triple role played by the activator enables one to explain the mechanism of the flashing-up without advancing complicated hypotheses. It has also been found in the new phosphors that the storing of light sum at deep local levels depends upon temperature at which the excitation has been effected. The flashing-up has been found to "freeze" at low temperatures. F. L.

535.37

5348. Some properties of ZnS-, ZnS . CdS- and ZnS . ZnSe-luminophores. BUNDEL, A. A. AND RUSANOVA, A. I. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13,** 173–87 (*Jan.–Feb.*, 1949) *In Russian.*—It is experimentally established that Fe, Co and Ni can act as activators for ZnS. Examination of ZnS . CdS luminophores containing up to 20% CdS by weight showed the existence of a Cd band at approx. 520 mμ, which was demonstrated to be due to Cd and not to any Cu present. It is shown experimentally by calcining ZnS at 1 000°c in an atmosphere of N_2 containing S vapour and using ZnS + NaCl in N_2 at 1 000°c as a control, that super-stoichiometric Zn is the activator in non-activated ZnS luminophores. Luminophores containing Zn and Cd easily extinguish in S vapour, luminophores containing Mn, Fe and Cu having high dissociation pressure extinguish only with difficulty, while in the case of Ag the sulphide could not be formed. These experiments indicate that not only Zn but other activators are present in ZnS luminophores in the form of atoms not connected with the S. For the case of ZnS . ZnSe luminophores it is established that the activators cannot only be metals but also metalloids, in this case Se. W. H.

535.37

5349. Emission-stimulating action of the exciting light in phosphors. ANTONOV-ROMANOVSKIĬ, V. V. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13,** 91–100 (*Jan.–Feb.*, 1949) *In Russian.*—A theory is proposed to account for the fact that the emission-stimulating action of the exciting light is a very common, if not the universal, effect. It is known that the absorption of the exciting light can take place both in the region of the fundamental absorption (that of the main ingredient) and in that relating to the activator. When the phosphor is irradiated by light in the region of fundamental absorption, the energy absorbed by the main substance is somehow transferred to the centre of luminescence which becomes ionized. The process is not a selective one. Hence it is quite possible that the energy absorbed is transferred not only to electrons in the centres of luminescence (excitation) but also to those in certain places of the lattice (stimulation of emission). Moreover, the spectral region of the emission-stimulating effect is, as a rule, wider than, and encompasses, the region of excitation. F. L.

535.37

5350. Nature of infra-red extinction in phosphors. KLEMENT, F. D. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*)

13, 141–8 (*Jan.–Feb.*, 1949) *In Russian.*—The views of P. Lenard and N. Ril on this subject are dismissed as over-simplifications and the question is raised whether the luminosity of phosphors (in this case ZnS–Cu phosphors) is due to ultraviolet radiation alone or to the latter combined with infrared. Graphs illustrate the rate of increase of luminosity of ZnS–Cu phosphors under (*a*) u.v. radiation alone, (*b*) u.v. radiation after treatment by i.r., (*c*) simultaneous u.v. and i.r. radiation, proving that in the latter case steady luminosity is established at a much lower level. As a result of the stimulation applied to recombined phosphors, e.g. CaS–Pb, a number of the electrons reach the zone of conductivity, and further i.r. radiation both increases luminosity and strongly reinforces light conductivity. ZnS–Cu phosphors, on the other hand, seem to be affected by i.r. light even when direct stimulation is absent, i.e. in the normal condition. The difference between the character of local levels in CaS–Pb phosphors and ZnS–Cu phosphors, those of the former substance being empty and those of the latter full, is explained by the author as due to the electrically negative character of the former and the electrically positive character of the latter. A mathematical explanation is given of the damping action produced by the presence of additional electrons in the zone of conductivity. J. C.

535.37

5351. An anomalous luminescent effect. UNDERWOOD, J. E. *J. Electrochem. Soc.*, **95**, 319–23 (*June*, 1949).—The luminescence caused by the radiations emitted from radon, when confined over a plane surface of phosphorescent ZnS, is not uniform. Bright and dark areas occur in a variety of unpredictable configurations and these areas slowly change their form and light intensity with time. Although some of the changes in luminosity are apparently affected by magnetic field, the real cause of the effect has yet to be found. The luminosity is sufficient to produce photographs through short time exposures without film fogging. Such photographs serve as records of the effect. A.

535.37 : 621.385.833

5352. A new fluorescent screen for the electron microscope. MERLING, K. B. Letter in *Nature, Lond.*, **163**, 541–2 (*April* 2, 1949).—A screen of Ag-activated ZnCdS is better than willemite, especially in brightness. S. T. H.

535.37 : 541.65

5353. The polarization of luminescence and the structure of molecules. FEOFILOV, P. P. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13**, 33–42 (*Jan.–Feb.*, 1949) *In Russian.*—A review discussing the polarization of the light emitted in luminescence and its dependence on the direction, with respect to the molecules, of the incident light, on wavelength, on solvent viscosity and on the electric or magnetic dipole or quadrupole nature of the transition. The examples are derived from practical work on some acridines. D. H. W.

535.37 : 541.65 : 548.0

5354. Luminescent properties of crystallo-phosphors and their chemical structure. KONSTANTINOVA-SHLEZINGER, M. A. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13**, 167–72 (*Jan.–Feb.*, 1949) *In Russian.*—Theoretical. A discussion of the fundamentals up which luminescence is based. The difference betwe the lattice structure of the two types of phosph those which do (e.g. alkali halides, ZnS) and whi do not (e.g. organic crystals, solid N, CdI_2) exhi recombination radiation, is that the bonds within former differ only in strength and not in natu whilst in the latter the structure involves varic types of bonds. The action of activators and nature of elements acting as such is consider Activators form a complex within the lattice, nature of the complex determining the luminescer of the entire structure. V.

535.37 : 6

5355. Luminescence of uranyl glasses and crysta SEVCHENKO, A. N. *Izv. Akad. Nauk, SSSR* (*S Fiz.*) **13**, 188–202 (*Jan.–Feb.*, 1949) *In Russian* Investigation of the polarization spectra of boron boro-silicate (II), phosphate (III), and alkali-silic (IV), samples of uranyl glasses show a definite relati between the spectra of I, II and IV and the excitin whereas there is no such relation for III. It see probable that the reason for the absence of "fin structure of the polarization spectra of III is action of P_2O_5 and not of modifiers such as Ba, M Ca, Na and K. The damping process in uranyl gl was investigated to 8 msec. II and IV show anom ous behaviour in that two damping processes w observed at room temperature. Concentrati depolarization of photoluminescence of uranyl gla and the effect of temperature −183° to +200°c polarization, duration of luminescence, and luminescence spectra of uranyl compounds were a studied. Examination of hydrated and dehydra uranyl nitrate, and sulphate did not confirm the d appearance of luminescence in dehydrated ura compounds. For uranyl sulphate the relati between amount, and duration of luminescence, a temperature were also investigated. W.

535.3

5356. The constitution of zinc beryllium silic phosphors and its effect on their luminous properti FONDA, G. R. *J. Electrochem. Soc.*, **95**, 304– (*June*, 1949).

535.3

5357. Two new "red" phosphors. ANDERSON, J. AND WELLS, R. S. *J. Electrochem. Soc.*, **95**, 299–3 (*June*, 1949).—A short account is given of the p paration and luminescent spectral emissions of zi barium sillicate : Mn and aluminum phosphate : S Mn phosphors. Both these phosphors can g spectra with high red content under 2 537 Å radiati

535.3

5358. An alumina–lithia–iron oxide phosph JONES, S. *J. Electrochem. Soc.*, **95**, 295–8 (*Ju* 1949).—A phosphor containing alumina, lithia a iron oxide is described. It is efficiently excited 2 537 Å radiation, emitting a band spectrum with energy peak at 6 800 Å and half its peak ener intensity at 6 520 and 7 320 Å.

535.3

5359. The light emitted by europium compoun PRZIBRAM, K. Letter in *Nature, Lond.*, **163**, 9 (*June* 25, 1949).—Refers to earlier work [Abs

956–8 (1935), 721 (1939)], to Freed and Katcoff's ecent work [Abstr. 2428 (1948)] indicating that ransitions in divalent Eu are responsible for the well-nown blue fluorescence and that the emission is nuch affected by the nature of the crystalline sur-oundings. J. E.

535.372

5360. Luminescence of NaCl–Ni-phosphor excited by X-rays. PARFIANOVICH, I. A. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13,** 161–6 (*Jan.–Feb.*, 1949) *In Russian.*—By means of electrolysis, Ni ions are ntroduced into the crystalline structure of NaCl. Such activation of NaCl crystals produces the phosphor, the luminescence of which is discussed. Thermo-luminescence and the analysis of the emitted spectrum are mentioned. The paper also deals with comparative measurements of the concentration of *F*-centres for both Ni-activated and unactivated NaCl crystals. W. W. G.

535.375 : 548.0

5361. Luminescence of coloured single crystals of alkali halide compounds. KATZ, M. L. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13,** 149–60 (*Jan.–Feb.*, 1949) *In Russian.*—[See Abstr. 3707 (1948)]. The luminescence of photochemically coloured alkali-halide (NaCl, KCl, KBr) single crystals was investigated as a function of temperature in connection with the spectrum of local energy levels and the luminous sum of luminescence as a function of the concentration of colour centres. A photon-counter with sensitized photocathode was used to make measurements in the u.v., and a photo-electric photometer with an Sb–Cs photocell and amplifier in the visible region. The mechanism of thermo-luminescence of the crystals in the u.v. and visible parts of the spectrum is discussed. W. R. S.

535.375.5

5362. Raman spectrum of potassium bromide. KRISHNAN, R. S. AND NARAYANAN, P. S. Letter in *Nature, Lond.*, **163,** 570–1 (*April 9*, 1949).—The Raman spectrum of KBr after exposure of 15 days is recorded and discussed. Values for the 9 eigen frequencies have been calculated and observed displacements have been assigned. W. R. A.

535.375.5

5363. On the Raman spectra of chloro and bromo-acetyl chloride in the solid state. SANYAL, S. B. AND MAJUMDAR, M. M. *Indian J. Phys.*, **23,** 1–12 (*Jan.*, 1949).—The Raman spectra of chloro- and bromo-acetyl chloride in the liquid and solid states, as well as the polarization of the Raman lines of these liquids, have been studied. It is observed that in the liquid state the former compound yields a smaller number of lines than the latter, which again gives many more lines than those expected theoretically. In the latter case some of the prominent lines disappear in the solid state, while in the case of chloro-acetyl chloride no such change takes place. New lines in the low frequency region appear in the solid state in both the cases. The changes observed in the case of bromo-acetyl chloride are ascribed to the formation of strongly associated molecules in which the C–Cl and C–Br valence forces in the molecule are affected in the liquid state. It is pointed out that in the case of propyl bromide also similar explanation was offered by previous workers. A.

535.376

5364. Extinction of cathodo-luminophores. MOSKVIN, A. V. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13,** 129–34 (*Jan.–Feb.*, 1949) *In Russian.*—The process is explained as taking place in three stages, the first two acting upon short-term illumination and the third upon long-term. The first stage is very short; the second is ascribed by the author to metastabilization and the third to recombination. The majority of cases examined showed the spectral structure to be identical at both the latter two stages. The typical luminosity curve of a cathodo-luminophore is first examined in its aspects of (*a*) progressive alteration in luminous intensity, (*b*) changes consequent upon electrode control. The damping curve of willemite (Zn_2SiO_4–Mn) is next compared with those of the cathodo-luminophores MgF_2–Mn[Mg, Zn]F_2–Mn and $Ca_2P_2O_7$–Dy. Finally, a comparison is drawn between the damping curves of ZnS–Cu as produced, (*a*) photographically, and (*b*) by the cathode. J. C.

535.376 : 539.164.9 : 537.542

5365. Luminescence under alpha-radiation. TIMOFEEVA, T. V. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13,** 135–40 (*Jan.–Feb.*, 1949) *In Russian.*—The brightness of the scintillations produced by the action of α-rays from Ra upon such substances as Zn sulphate, willemite and diamonds is shown to depend quantitatively upon the dimensions of the crystals. Two methods of proof by microscopic means are described and graphs illustrate the relation between degrees of brightness and the linear measurements, area and volume, respectively, of the crystal used. Results are also illustrated graphically for multiple scintillations related to the linear dimensions and volume of 25 crystals and for single sparks related to the volume only of a crystal. A table shows the dependence of the probability of a given rise of the scintillation curve within a given time on the amount of diffraction acting on the source of stimulation for crystals of various sizes. J. C.

535.39

5366. Reduction of optical reflectivity of glass surfaces resulting from ion bombardment. KOCH, J. Letter in *Nature, Lond.*, **164,** 19–20 (*July 2*, 1949).—In a quantitive study of this phenomenon, which was accidentally discovered, crown glass plates were bombarded on both sides by $\sim 20\ \mu A/cm^2$ of 60 keV Kr^{84} ions. The reflectance was rapidly reduced at first, approaching a constant value after several hours. Values of the transmittance as a function of wavelength, before and after bombardment, are tabulated; at $\lambda = 550\ m\mu$, T was increased from 91 to 96·8%. The treated surface withstood heating to 400°c, treatment with nitric or chromo-sulphuric acid and rubbing. Flint glass and all types of crown glass showed similar effects. Ions of A and Xe gave smaller effects, but Ne, He, H^+ produced little or no optical effect. Some ions caused colour changes in the surface. Further experiments are needed for a full explanation, but the reduction in reflection must be caused by the formation of a layer $\sim\lambda/4$ thick, with progressively varying refractive index. T. G. P.

535.417.

5367. A new interferometer. JOHNSON, E. R. AND SCHOLES, J. F. M. *Aust. J. Sci. Res. A*, **1**, 464–71 (*Dec.*, 1948).—A new interferometer, especially suitable for studying aerodynamic fields, in which a parallel beam of light passes once through the field, is described. The dividing plates and the optical components in the auxiliary beam are small, though the main beam covers a wide field. The relevant theory and an outline of a method of adjustment are given, and possible development to replace lenses with mirrors and to improve light transmission is indicated. A.

535.417 : 531.717

5368. Interferometric determination of the apparent thickness of thin metallic films. AVERY, D. G. Letter in *Nature, Lond.*, **163**, 916 (*June* 11, 1949).—In connection with the method for determining film thickness by depositing an opaque reflecting layer over the edge of the film and then (interferometrically) measuring the step, evidence is presented showing that there is a "packing-in" effect. Presumably this is due to filling up of the interstices in the film. It is suggested that use of this method may lead to errors of up to 30%. A. H.

535.417 : 531.74

Measurement of small surface angles. *See Abstr.* 5269

535.42

5369. Diffraction of plane light waves by black screens. DURAND, E. *Rev. Opt. (Théor. Instrum.)* **28**, 325–51 (*June*, 1949) *In French.*—A Fourier integral formula, rigorously equivalent to Kirchhoff's, is used. Its advantage is that it may be applied both to Fresnel and Fraunhofer diffraction. Various examples are discussed. L. P.

535.42

5370. Diffraction at a double grating. LAU, E. *Ann. Phys., Lpz.* [*Folge* 6] **2** (*Nos* 7–8) 417–23 (1948) *In German.*—It is proved that, if two similar gratings are placed one after the other, the second forms a series of images of the first at distances given by a simple formula. This theoretical conclusion was verified experimentally. L. P.

535.43

5371. Tables of scattering functions for spherical particles. *Nat. Bur. Stand., Appl. Math. Ser.* (*No.* 4) *pp.* xiii + 119 (1949).—The tables are of: (1) the intensity functions giving the angular distribution of intensity and total light scattered by a small spherical particle, as a function of $2\pi r/\lambda$, when the radius, r, of the particle, is approx. equal to the wavelength, λ, of the light; (2) the total scattering coefficient for transparent and absorbing materials. The tables are extended to certain values of complex arguments for a problem in microwave radar, relating to the echoes received on radar sets from suspended or falling water droplets in the atmosphere. L. S. G.

535.43

5372. Experimental arrangement for study of scattering of light [by suspensions]. TONNELAT, J. AND GUINAND, S. *C.R. Acad. Sci., Paris*, **228**, 602–4 (*Feb.* 14, 1949) *In French.*—Light from a Hg vapour lamp is divided into two beams; one traverses the suspension, and the scattered light falls on a photo cell; the second beam passes through an optic wedge, and then to the same photocell. The settin of the wedge is adjusted till the photocurrent is th same whichever beam falls on it, and is therefore measure of the proportion of light scattered. Th apparatus has been used for study of the tobacc mosaic virus (results not quoted). N.

535.4

5373. Scattering by an inhomogeneous solid DEBYE, P. AND BUECHE, A. M. *J. Appl. Phys.*, **20** 518–25 (*June*, 1949).—A general treatment of th scattering of radiation by an inhomogeneous materia is developed. It is shown how scattering measure ments can be used to obtain the average square of th fluctuations in refractive index or electron densit and a correlation function which measures the degre of correlation between two fluctuations as a functio of their distance of separation. The scattering o visible light by Lucite and two glass samples hav been investigated. The data are analysed in term of the quantities mentioned above. It is found tha the extensions in space of the inhomogeneities in th Lucite sample are much greater than those in th optical glass samples investigated. The magnitude of the fluctuations in refractive index are found to b dependent on the composition of the sample. A

535.

5374. Design of a quasi-achromatic quarter-wav plate using two plates of the same crystalline materia DESTRIAU, M. G. AND PROUTEAU, J. *J. Phys. Radium* (*Sér.* 8) **10**, 53–5 (*Feb.*, 1949) *In French.*—By the com bination of two plates, one a $\lambda/4$ and the other $\lambda/2$ plate with respect to the mean wavelength of th region to be achromatized, it is shown how to produc an achromatized $\lambda/4$ plate. An example has bee tested experimentally by measuring the extinctio produced by an analyser. In the region 0·61–0·436 the ratio of the minimum to maximum transmissio showed a variation of 0·79–0·93, while a simpl $\lambda/4$ plate showed a variation of 0·49–0·96. H. H. HOP

535.5

5375. Tilting-plate compensators. SMITH, F. H Letter in *Nature, Lond.*, **163**, 442–3 (*March* 19, 1949).— A form of tilting plate compensator consisting of tw optically identical birefringent plates mounted on upon the other with their vibration planes mutuall perpendicular is suggested. It can be made fro almost any birefringent material; mica is suggested a being the best. The one described consists of tw selenite plates of 2·5 mm thickness giving a com pensating range of about 4 λ. H. G.

535.5

5376. Photo-elastic creep in "Catalin 800" an CR 39. BRAYBON, J. E. H. Letter in *Nature, Lond* **163**, 689 (*April* 30, 1949).—The results of experiment to determine the variation of the stress optic coefficien (C_λ) with time (photo-elastic creep) are discussed fo Catalin 800 and CR 39. For $\lambda = 5\,000$ Å it wa found that $C_\lambda = c_0 + c_1 t^{0\cdot3}$ for Catalin tested fo 24 hr, whereas for CR 39 tested for 400 hr $C_\lambda = c_0' + c_1' [1 - \exp(-kt^{\frac{1}{2}})] + c_2' t$ (c_0, c_1, c_0', c_1', c and k are constants dependent on the material t = time in hr). For $t \ll 450$ the term $c_2' t$ can b neglected, but for $t > 450$ it should probably b

eplaced by an exponential term. Analogous results old for mechanical creep. H. G. J.

535.8 : 535.313

377. A new high aperture catadioptric objective. BERTI, L. *Nuovo Cim.*, **6**, 131–4 (*March*, 1949) *In Italian.*—The aberration of a spherical mirror s corrected by means of a concentric two-glass chromatic refracting system. An aperture of /0·47 is claimed with a focal length = 39 m/m. H. H. HOP.

535.81 : 666

378. New optical glasses. KINGSLAKE, R. AND DEPAOLIS, P. F. *Nature, Lond.*, **163**, 412–13 (*March* 2, 1949).—A survey of the production and properties of the new Kodak glasses of the rare-element/borate and fluoride types. H. H. HOP.

535.82

379. A unit-magnification optical system with long working distance for microscopical applications. DYSON, J. Letter in *Nature, Lond.*, **163**, 400 (*March* 12, 1949).—A spherical concave mirror is used in conjunction with a half-silvered glass plate having a weak convex curve on the side nearer the object. By this means spherical aberration and coma are corrected for N.A. = 0·5 with a working distance of 34 m/m. An immersion system enables the use of N.A. = 0·75. The working distance for a similar conventional microscope is 2 m/m. H. H. HOP.

535.822.3

380. Microscopes for the examination of nuclear research emulsions. DUNBAR, D. N. F. AND BOWER, J. C. Letter in *J. Sci. Instrum. Phys. Ind.*, **26**, 132–3 (*April*, 1949).—A magnified image of a small area of the plate is projected on to a screen; the plate is moved past the microscope objective in discrete steps. Positions of tracks on the plate are determined from the displacement of the object rather than by eyepiece graticules, and the precision is such that coordinates may be determined to better than 0·0001 in. Plates can be searched at almost double the normal rate. Constructional details are given. N. C.

535.827 : 621.385.833

381. Correlation of optical and electron microscopy. BRYNER, J. S. *Metals Tech.*, **15** (*No.* 2364) 7 *pp.* (*June*, 1948).—In the study of metallographic specimens there is need for a method of locating the same field in both the optical and the electron microscopes. The problem is solved by a specially designed specimen screen, containing an opening which can be identified and quickly located in the electron microscope, fastened to the silica film replica in such a position that the desired field on the specimen is located at the identifiable opening in the specimen screen. The design of such a screen, a method for producing it, and a technique for fastening it to the silica film replica are described. M.-V. (R)

HEAT 536

536.2

382. The effect of pressure on the maximum heat flow during the boiling of water in large volume. KAZAKOVA, E. A. *Izv. Akad. Nauk, SSSR, Otdel Tekn. Nauk* (*No.* 1) 64–9 (*Jan.*, 1949) *In Russian.*—This is investigated in a high-pressure steel apparatus in which a wire heated by an electric current serves as the heating surface. Two wires were used, one of Cu 0·135 mm dia. and one of nichrome 0·29 mm dia., pressures up to 70 atmos. being used with the former and up to 115 atmos. with the latter. The heat flow from the wires carried away by water, which is cooled by a condenser system, was determined by measuring the electrical energy dissipated, the max. value q_{max} being that at which the wire melts due to transition to "film" boiling. It was found that q_{max} increases appreciably with increasing pressure. At pressures of 50–79 atmos. q_{max} attains its highest value, further increase in pressure leading to a decrease, and at 115 atmos. q_{max} for the nichrome wire has the same value as for 15 atmos. If q_{max} was 800 000–1 000 000 Kcal/m² for both wires at atmospheric pressure, then with increasing pressure q_{max} for Cu wire reached a value of 2 500 000 and for nichrome 4 500 000 Kcal/m². W. H.

536.2 : 535.32

383. Temperature inversion by convective cooling. LAWSON, R. W. Letter in *Nature, Lond.*, **164**, 71–2 (*July* 9, 1949).—A student form of apparatus for R. W. Wood's experiment on the anomalous dispersion of Na vapour is briefly described. The inverse effect, a mirror image of the anomalous effect about the normal axis of dispersion, appearing soon after the gas heating is removed, has been examined for various gas flame sizes. It is concluded that an inversion of the temperature gradient across the steel tube containing the vapour is developed. S. W.

536.21

384. Influence of humidity on the thermal conductivity of granular solids. DEVIENNE, M. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 8) 238–45 (1949) *In French.*—Thermal conductivity of a cylinder containing glass spheres (diameter not given) was found from measurements of axial temperature changes after immersion of the cylinder in ice-cold water. The cylinder was initially evacuated and air with known amounts of water vapour admitted. The conductivity variations roughly follow a logarithmic law. This is indicated by a theory which assumes that the condensed liquid at the contact of the spheres is the main cause of the increased conductivity. T. S. E. T.

536.21 : 537.312.62

Thermal conductivity of superconductors. *See Abstr.* 5442

536.241

385. A comparison of different methods of calculation in problems on heat conduction. KAUFMAN, W. *Maschinenb. u. Wärmewirtsch.* [*MuW*] **4**, 81–7 (*June*, 1949) *In German.*—The problem of the temp. distribution, during the heating period, along the axis of a binding screw which is holding together two plates subjected to a heating process, is considered, and approximate graphical methods for the rapid determination of the max. difference between the mean temp. and the mid-point temp. of the screw discussed at length. S. W.

536.421

386. Theory of fusion. OCHIAI, K. *Proc. Phys.-Math. Soc. Japan*, **24**, 261–9 (1942) *In German.*—

Order-disorder transition in Lennard-Jones and Devonshire's theory of fusion is treated more minutely. The mol. arrangement in a fluid can be treated analogously to the super-lattice in the theory of alloys, but some modifications are added. S. C. A. P.

536.421.1

5387. Determination of the melting point of edible fats. FRANÇOIS, M.-T. AND RÉGENT, M. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 8) 227–30 (*May*, 1949) *In French.*—The results of measurements made on ternary mixtures of suet, coconut and peanut oils, and on quaternary mixtures with hydrogenated whale oil, by the open capillary tube, the mercury bath, and the photometric method of Woog, Givaudon, Sigwalt and Lienhart [*Bull. Soc. Chim. Fr.*, **5**, 439–42 (1936)] are tabulated and compared. S. W.

536.421.4

5388. On a dilatometric cryometer. SWIETOSLAWSKI, W. *Bull. Int. Acad. Polon. Sci. Lett., A* (*Nos* 7–10) 113–26 (*July–Dec.*, 1948) *In English.*—Several forms of the dilatometric cryometer, which is a modification of the differential cryometer [Abstr. 390 (1944)] enabling the percentage of unfrozen liquid to be determined to any required precision, and their method of use, are described. Samples of benzene, containing 0·009, 0·06 and 0·16% impurity, were tested in a dilatometric cryometer and the results are shown graphically. The method of calculating δT, the difference between the freezing points of 100% pure benzene and the sample, is described. Values for δT for the three samples are given. S. W.

536.422

5389. Sublimation in outdoor air and seeded sublimation. CWILONG, B. M. Letter in *Nature, Lond.*, **163**, 727–8 (*May* 7, 1949).—Following upon the discovery of the seeding properties of AgI [Abstr. 3180 (1947)] tests are described of the tendency of these microcrystals to initiate the sublimation of water vapour in an expansion chamber and on the test-plates of hoar-frost hygrometers. These experiments are related to expansion chamber tests of the threshold temp. for the formation of ice crystals in supersaturated air under various weather conditions. A. C. C.

536.422

5390. The rate of evaporation of droplets. II. The influence of changes of temperature and of the surrounding gas on the rate of evaporation of drops of di-*n*-butyl phthalate. BIRKS, J. AND BRADLEY, R. S. *Proc. Roy. Soc. A*, **198**, 226–39 (*Aug.* 15, 1949).—The vapour pressure of di-*n*-butyl phthalate has been determined by Knudsen's method at 15 to 40°C and is given by $\log_{10} p$ (in microns) $= -4\,790/T + 14{\cdot}502$. The latent heat of evaporation is 21 900 cal. per mole. Rates of effusion through a small hole in the presence of pressures of air 2 to 0·01 cm have also been determined and shown to conform to the equation rate of loss of mass $= A/(B + P)$, where A and B are constants. The rate of evaporation of drops of di-*n*-butyl phthalate about 0·5 mm in radius has been determined at 15 to 40°C, in air at pressures 20 to 0·01 cm and in H at 19·90°C and Freon 12 (CCl_2F_2) at 19·90 and 30·00°C and has been accounted for theoretically. Within the experimental error the evaporation coeff. is unity at all temps. The diffusion coeff. D in air at 76 cm varies from 0·0341 to 0·0473 for a temp. variation 15 to 40°C, D being $\propto T^3$. The diffusic coeff. in H at 19·90°C is 0·153 for 76 cm, and fo diffusion in Freon 12 at 76 cm is 0·0126 at 19·90 and 0·0140 at 30·00°C. The collision radius di-*n*-butyl phthalate is 4·45 Å as determined from th experiments in air at 19·90°C and the sum of the rad of di-*n*-butyl phthalate and air molecules is $\propto T^-$ From the experiments in H the collision radius di-*n*-butyl phthalate is 4·68 Å at 19·90°C and fro the experiments using Freon 12, 5·24 Å at 19·90°. The shape of the drops has been studied, and erro introduced by assuming a spherical shape are show to be negligible. [For Pt. I see Abstr. 320 (1947)].

536.42

5391. The rate of evaporation of droplets. III Vapour pressures and rates of evaporation of straigh chain paraffin hydrocarbons. BRADLEY, R. S. AN SHELLARD, A. D. *Proc. Roy. Soc. A*, **198**, 239–5 (*Aug.* 15, 1949).—The vapour pressures, latent hea of vaporization and fusion and diffusion coeffs. the vapours in air, have been determined at 15 t 40°C, by a combination of Knudsen's vapour-pressur technique and studies on the rate of evaporation drops and solid beads, for *n*-$C_{16}H_{34}$, *n*-$C_{17}H_{36}$ an *n*-$C_{18}H_{38}$. The rates of evaporation of drops and soli beads agree with the previously published theory, an lead to a value of unity for the evaporation coef A new experimental method is described for dete mining the self-cooling on evaporation of a dro The bearing of the results on the size and shape hydrocarbon molecules is discussed.

536.42

5392. A new technique for the determination heats of sublimation of slightly volatile substance SIMPSON, O. C. AND THORN, R. J. *Rev. Sci. Instrum* **20**, 504–7 (*July*, 1949).—A technique is describe which enables one to measure relative vapour pressure by measuring the rate of change of transmissivity thin deposits as they are formed by condensation fro the vapour. From the temp. dependence of this ra the heat of sublimation of slightly volatile substance can be determined. In the case of graphite, deposi of the order of 0·1 μg per cm² can be detected.

536.422

5393. Vaporization of titanium. CARPENTER, L. G AND REAVELL, F. R. Letter in *Nature, Lond.*, **16** 527 (*April* 2, 1949).—Gives experimental data o rate of evaporation and total radiation from *in vacuo*. The latent heat of vaporization is deduce L. G.

536.42

5394. Allotropic transformations in titaniu MCQUILLAN, A. D. Letter in *Nature, Lond.*, **164**, (*July* 2, 1949).—Measurements of the variation equilibrium hydrogen pressure with temperature f a solution of 0·02 atom % H_2 in 99·9% Ti met showed two distinct transformations at 864°C an 900°C, and a third allotropic modification stab between these temperatures. H. P. M

536.4

5395. Effects of very fine solid particles on flam propagation. BURGOYNE, J. H. AND THOMAS, N Letter in *Nature, Lond.*, **163**, 765–6 (*May* 14, 1949).— Particles were introduced into flames by passing th

r supply through arcs between various electrodes e, Cu, C, etc.). In many cases the inflammability nge for the fuel (H_2, CH_4, C_2H_4) was widened. xaminations were made of flame spectra. A. G. G.

536.48

396. The rare isotope of helium He^3: a key to the range properties of ordinary liquid helium, He^4. ONDON, F. *Nature, Lond.*, **163**, 694–6 (*April* 30, 949).—Short review of present theories and experiental results. 8 refs.

536.48

397. The use of liquid helium in magnetic cooling xperiments. HUDSON, R. P., HUNT, B. AND KURTI, . Letter in *Proc. Phys. Soc. A*, **62**, 392–4 (*June*, 949).—The problem of cooling liquid He below 1°K ly the magnetic method is discussed. With an arrangeent where the experimental vessel was connected by capillary to a similar vessel above it, the heat inflow rom above was practically eliminated as long as the pper vessel was below 0·5°K, and a temperature of ·1°K could be maintained in the lower vessel for 0 minutes. D. S.

536.48

398. Viscosity and superfluidity in liquid helium. OWERS, R. AND MENDELSSOHN, K. Letter in *Proc. Phys. Soc. A*, **62**, 394–5 (*June*, 1949).—It is shown by measurements of flow through capillaries that the viscosity of liquid He begins to fall off rather rapidly below 2·7°K with no break at the λ-point. It is suggested that this is associated with the fall of entropy in the same temperature interval, and that since these effects cannot be due to fluctuations, they represent the setting-up of some kind of short-range order in momentum space above the λ-point. D. S.

536.48

5399. The effect of impurities on the thermodynamic properties and speed of second sound in helium II. POMERANCHUK, I. *J. Exp. Theor. Phys., USSR*, **19**, 42–53 (*Jan.*, 1949) *In Russian.*—According to Landau's theory the velocity u_2 of second sound should, as 0°K is approached, rise towards a limiting value $1/\sqrt{3}$ of the velocity of ordinary sound. It is shown that impurities, such as He^3, even in very small concentrations, should cause the temperature variation of u_2 to depart from Landau's prediction and fall instead to a very small value (depending on the concentration of impurities) at 0°K. D. S.

536.48 : 531.19

5400. Transport phenomena in a Bose–Einstein gas. BAND, W. *Phys. Rev.*, **75**, 1937–46 (*June* 15, 1949).—Develops the formal first order perturbation theory of transport phenomena in an ideal Bose–Einstein gas. The perturbation relaxation time is an unknown parameter in the theory. The ratio of thermal conductivity to viscosity is independent of this relaxation time; it increases discontinuously by a factor almost 2 at the Bose–Einstein condensation temperature T_λ. The isothermal Knudsen heat of transport through a small hole, classically equal to $2kT$, drops rapidly to zero as T falls to T_λ: the Bose–Einstein gas flowing isothermally through a small hole carries no heat when its temp. is below T_λ and it exhibits corresponding thermo-mechanical effects. The mathematical analysis is carried out in terms of an approximation in which the lowest energy states of the gas are treated discretely while above an arbitrary level they are treated by an integration approximation. The treatment is capable of generalization to models in which there are anomalies in the lowest level spacings. A.

536.48 : 536.22 : 534.22

5401. Dispersion of second sound at low frequencies. PESHKOV, V. P. *J. Exp. Theor. Phys., USSR*, **19**, 270–1 (*March*, 1949) *In Russian.*—An incongruity in Kapitza's work [*J. Exp. Theor. Phys.*, **11**, 1 (1941)] on the reaction of a filament of the heat flow on a vane is investigated, the heat flow being regarded as a second-sound wave of zero frequency. No indication of the existence of dispersion of the second sound in the range investigated, i.e. between 10 and 250 c/s, could be found; when taken with findings by other authors, it can safely be assumed that there is no dispersion in the second sound between 10 kc/s and 1/25 c/s. B. F. K.

536.48 : 536.24

5402. Heat transport in helium II. ANDRONIKASHVILI, E. L. *J. Exp. Theor. Phys., USSR*, **19**, 535–42 (*June*, 1949) *In Russian.*—The dependence of heat transport and fountain pressure in He II across slits and capillaries on the temperature gradient is discussed and related to the viscosity of the normal component of the liquid. It is claimed that Mellink's data [Abstr. 2874 (1947)] on the fountain pressure in wide slits require correction for the difference of vapour pressures on the two sides, and this destroys the proportionality over a wide range between fountain pressure and heat transport which is the basis of a frictional term between superfluid and normal components introduced by Gorter [Abstr. 1872 (1948)]. According to the author this proportionality holds only for low heat flow and breaks down at a critical flow velocity. D. S.

536.48 : 536.423.15

5403. Tables of vapour pressure of liquid helium. VAN DIJK, H. AND SHOENBERG, D. *Nature, Lond.*, **164**, 151 (*July* 23, 1949).—Agreement has been reached on the form of $p - T$ relation to be used for determinations of temp. from vapour pressure, and tables embodying this relation for practical use are available.

536.48 : 538.222

Magnetism and the third law of thermodynamics. Magnetic properties and heat capacity of $CoSO^4 . 7H_2O$ from 0·1 to 15°K. *See Abstr.* 5570

536.5

5404. A note on the care of liquid-in-glass thermometers. DURHAM, J. G. Note in *J. Sci. Instrum. Phys. Ind.*, **26**, 205–6 (*June*, 1949).—Defects arising from transit or undue vibration, and methods of curing them, are briefly discussed. Impurities in the bore; trapped gas in the bulb, or in the contraction chamber; detached Hg at the top of the contraction chamber or in the expansion chamber; divided column; and badly shaped bulb, contraction, or expansion chamber, are separately considered. S. W.

536.587 : 621.316.74 : 621.365.5

5405. The regulation of temperature in the application of high frequency induction heating to thermodynamic measurements. SPEISER, R., ZIEGLER, G. W.,

JR. AND JOHNSTON, H. L. *Rev. Sci. Instrum.*, **20**, 385–8 (*June*, 1949).—An apparatus described regulates the temp. by varying the inductance in series with the work coil so as to maintain the current through the latter constant. Except for a negligible error due to a small percentage change in frequency, the energy transferred to the work can be held constant. The apparatus can be used in meas. of vapour pressure, in calorimetry and in X-ray diffraction studies at high temp. A.

536.62.089.6 : 621.317.39.089.6

5406. Electrical calibration of calorimeters. GREGORA, O. AND KARAS, F. *Elektrotech. Obz.*, **38**, 94–101 (*March* 1, 1948) *In Czech.*—A provisional layout and method for d.c. calibration is given, the experimental results obtained being compared with calibration results obtained by use of benzoic and salicylic acids. Sources of error are determined and correction methods suggested. A new relation for heat exchange calculations is derived which is generally valid and particularly useful in the electrical calibration of calorimeters. B. F. K. (R)

536.631

5407. The Debye temperature and electronic specific heat of nickel. KUBO, T. *J. Phys.-Math. Soc. Japan*, **17**, 464–7 (1943).—In the calculations of Debye's characteristic temp. and elastic constants of Ni, the idea that the ferromagnetic substance consists of magnetic domains has been taken. The Debye temp. calculated is 472°K for Ni, larger than Keesom and Clark's result 412°K obtained from the elastic constants. The contribution of electrons to the specific heat has been discussed using the above value of the characteristic temp. S. C. A. P.

536.655

5408. Heat of vaporization and surface energy of several liquids. HARASIMA, A. *Proc. Phys.-Math. Soc. Japan*, **23**, 977–83 (1941) *In English.*—Heats of vaporization of several simple liquids, i.e. He, H, D, Ne, N and A were calculated by using the same data by which the author calculated surface energies [see Harasima, *ibid.*, **22**, 825 (1940)]. By use of the intermolecular potential

$$\phi(r) = \phi_0\{(r_0/r)^{12} - 2(r_0/r)^6\}$$

ϕ_0 and r_0 being constants, the heat of vaporization for liquids with face-centred cubic type molecular arrangement is given by

$$Q = \frac{N}{2}\phi_0\{28{\cdot}9(r_0/a)^6 - 12{\cdot}1(r_0/a)\} - \tfrac{1}{2}RT$$

where N is the Avogadro number, a the distance between neighbouring molecules and R the universal gas constant. S. C. A. P.

536.68 : 621.369

5409. On the non-proportionality of the heating power of an enclosure to the heating of the air in it. PARODI, H. *C.R. Acad. Sci., Paris*, **227**, 719–20 (*Oct.* 11, 1948) *In French.*—Experiments performed over several years on a large number of railway coaches have confirmed that the relationship between the heating power W (watt/m³) and the rise in temperature produced $\Delta\theta$ (°c) is $W = k(\Delta\theta)^\beta$ where k is const. and $\beta \simeq 2$. The investigations were extended to buildings heated by electricity, and the same relationship found to hold. β for differ types of construction was 1·25–2. S. W.

THERMODYNAMICS 536.7/.8

536.71 : 541

Equation of state for polystyrene. *See Abstr.* 5

536

5410. Thermodynamics of the system KHF_2–KF–H including heat capacities and entropies of KHF_2 : KF. The nature of the hydrogen bond in KH WESTRUM, E. F., JR. AND PITZER, K. S. *J. Am Chem. Soc.*, **71**, 1940–9 (*June*, 1949).

536

5411. Thermodynamic properties of diiodoacetyl and some symmetrical-top acetylenes. ZIOMEK, J. AND CLEVELAND, F. F. *J. Chem. Phys.*, **17**, 578– (*June*, 1949).

ELECTRICITY 537

537 : 537.71 : 621.3.081 : 53.0

Some units in the Giorgi system and the C.G system. *See Abstr.* 5231

THEORY . ELECTRONS 537.1

53

5412. Recent developments in the theory of electron. WEISSKOPF, V. F. *Rev. Mod. Phys.*, 305–15 (*April*, 1949).—The original classical theory the electron and the new difficulties introduced quantum theory and positron theory are stated as as possible in non-mathematical terms, in order explain recent theoretical attempts to calcul observable effects peculiar to quantum electr dynamics. Finally the experiments on the Lar shift of the hydrogen levels and the anomalo magnetic moments of the electron, and their theoreti interpretation are discussed. G. J.

537.

5413. Intermediate treatment method of electro in solids. SAWADA, S. *J. Phys.-Math. Soc. Japa* **17**, 355–7 (1943).—Since the properties of co paratively inner electrons, for example *d*-electro contributing to ferro- or para-magnetism, can neith be explained satisfactorily by the Heitler–Lond method nor the Bloch method, an intermediate trea ment method of electrons in solids has been propose This method considered that some of the atoms solids are in discrete atomic states, and the othe constitute large or small atom blocks. S. C. A.

537.1

5414. The electronic charge and the oil drop metho HOPPER, V. D. *Aust. J. Sci. Res. A*, **1**, 1369–99 (*De* 1948).—A study has been made of Millikan's oil dr method for determining the electronic charge. Owi

the uncertainty in the value of the viscosity of air, e value of the ratio $e^{2/3}/\eta_{23}$ has been determined d quoted rather than the electronic charge. Some the factors that have been found to influence this termination are (1) the purity of the air; (2) the luence on the field of the hole in the top plate and e layer of oil which collects in the lower plate of e condenser; (3) corrections to Stokes's equation e to the influence of the walls of the apparatus;) oxidation of the oil; and (5) impurities in the oil. om a study of 47 drops of butyl sebacate, and using okes's analysis for the resistance to a sphere moving a viscous medium, the value

$e^{2/3}/\eta_{23} = (335{\cdot}75 \pm 0{\cdot}11)\times 10^{-5}$ (e e.s.u., η_{23} c.g.s.)

s been obtained. This will be increased slightly if seen's modification to Stokes's analysis is applied, t the increase will be $< +0{\cdot}04\%$. A.

537.122

5415. The oil-drop method for the determination of e electronic charge. HOPPER, D. V. *Nature, Lond.*, 3, 733–5 (*May* 7, 1949).—Movements of oil drops Millikan apparatus were photographed at $\frac{1}{5}$ sec tervals by synchronized sparks. Measurements of e ratio (charge)$^{2/3}$/(viscosity at 23 c), which is dependent of the absolute value of viscosity, show at errors can be caused by (i) purity of air, i) oxidation of oil drop, (iii) impurities in oil (steel rticles). A table giving values of viscosity of air btained from the results of other workers shows that is is still a major source of error in Millikan's periment. T. S. E. T.

537.122

5416. On the external polarization of the vacuum. SNYDER, H. S. Letter in *Phys. Rev.*, **75**, 1623 (*May* 15, 949).—The vacuum expectation values of stated finitions of charge and current density of an ectron-positron field in an external electromagnetic ld are found to be zero. It is argued that the oblem is merely a matter of the proper definition the vacuum. G. J. K.

537.122 : 530.145

Magnetic polarizability of the electron. *See Abstr.* 254

LECTROSTATICS . DIELECTRICS 537.2

537.212 : 621.319.4

5417. The electric field of a condenser of which one late is an arc and the other a radius of a circular linder. DAVY, N. *Phil. Mag.*, **39**, 510–18 (*July*, 948).—The field distribution is exactly determined y means of a conformal transformation involving liptic functions. The lines of force are determined nd the surface charge density on the electrodes is alculated. The capacitance of the condenser is ound and diagrams of the field distribution are iven. L. S. G. (R)

537.221 : 621.319.7

5418. Frictional electrification. GILL, E. W. B. ND ALFREY, G. F. Letter in *Nature, Lond.*, **163**, 172 *Jan.* 29, 1949).—The frictional charges acquired by dielectrics such as ebonite and sand when sliding over an earth-connected inclined metal plane, are affected to a considerable extent when an external electric field is applied between the plate and another plate placed above and parallel to it. The charge, Q, is given by $Q = -AX - Q_0$, where X is the electric field (pos. or neg. according as the upper plate is pos. or neg.), A is a constant and Q_0 is the charge produced in zero field. With neg. fields, Q is reduced and can be made zero when $X = -Q_0/A$. These effects are of interest not only in throwing light on the mechanism of frictional electricity, but may be also of practical significance, since by applying an external field, the frictional charges may be so reduced that dangers resulting from frictional electrification are eliminated. E. R.

537.226

5419. Dielectric properties and premelting in ketones. DANIEL, V. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref.* L/T200) 13 *pp.* (1948).—Measurements of the dielectric properties of two ketones have been made to test Fröhlich's theory [Abstr. 2117 (1946)] and the measurements are correlated with measurements of thermal expansion which provide a measure of premelting. Good agreement is obtained on the whole with Fröhlich's theory. A qualitative theory of premelting is advanced, and the premelting properties of the two ketones are correlated with the structure. E. R.

537.226

5420. On the mechanical forces in dielectrics. SMITH-WHITE, W. B. *Phil. Mag.*, **40**, 466–79 (*April*, 1949).—There are 2 formulae for the force, one due to Helmholtz, the other to Poisson–Kelvin. It is shown that the latter is consistent with the principle of energy and that Helmholtz's theory is incompatible with the Poisson–Kelvin views on the cause of dielectric behaviour. The view of Larmor that the Helmholtz energy method is unsound is supported. L. S. G.

537.226 : 548.7

Lattice theory of dielectric and piezoelectric constants in crystals. *See Abstr.* 5786

537.226.2

5421. Dielectric absorption in crystalline long-chain ketones. MEAKINS, R. J. Letter in *Nature, Lond.*, **163**, 840 (*May* 28, 1949).—The effects of dipole interaction in solid solutions of long-chain polar compounds in paraffins were investigated by dielectric measurements on laurone ($C_{23}H_{46}O$) in a non-polar solvent, *n*-hexacosane, at various concentrations, for the frequency range 60 kc/s to 50 Mc/s, and at room temp. Graphs of log. frequency v. tan loss angle show the dielectric loss to increase at first, but later to decrease with increasing concentration. The results are explained in terms of the Debye theory, and comparison with results for several long-chain esters shows more dipole interaction in the ketones than in the corresponding esters. C. A. H.

537.226.2 + 537.311.3

5422. The dielectric constant and conductivity of blood at ultra high frequencies. RAJEWSKY, B. AND SCHWAN, H. *Naturwiss.*, **35** (*No.* 10) 315–16 (1948) *In German.*—A brief theoretical study of combined molecular and particle size effects leads to dispersion

curves over the range 0·36 to 10 m wavelength agreeing well with expt. Variations of permittivity are due mainly to corpuscle size, those of conductivity to molecular resonance. F. T. F.

537.226.3

5423. Relaxation phenomena. KUBO, R. *J. Phys.-Math. Soc. Japan*, **16**, 243–9 (1942).—In relaxation phenomena such as absorption of supersonic wave, dielectric loss, paramagnetic dispersion, etc., time of relaxation plays an important role. In polydisperse system, in which various times of relaxation coexist, the distribution function of time of relaxation must be known. It is shown theoretically that, when Boltzmann's equation expressing the time variation of the distribution function of the system is given, the time of relaxation can be obtained as a solution of an eigenvalue problem and that some information regarding the distribution of time of relaxation can easily be obtained. The results are applied to the problem of dielectric loss as well as of the electric conduction of metals. S. C. A. P.

537.228.1

5424. Piezo-electric properties of alpine quartz crystals. HEDINGER, R. *Diss. Eidg. Tech. Hochschüle, Zürich*, 115 *pp. Kilchberg Schmidberger u. Müller, Berlin* (1948) *In German.*—The paper is in two parts, the first summarizing the fundamentals of the subject of piezo-electricity and the second describing vibration measurements made on selected crystals; the latter show that, although the piezo-electric properties are similar to those of quartz of Brazilian origin, the reproducibility, particularly as regards temp. coeff., is not as good, probably because the alpine material has a lamellar structure. H. J. H. S.

537.228.1 : 621.317.331 : 621.396.611.21

5425. The measurement of the series-resonant resistance of a quartz crystal. ROSENTHAL, L. A. AND PETERSON, T. A., JR. *Rev. Sci. Instrum.*, **20**, 426–9 (*June*, 1949).—Three instruments are described which will measure the equivalent resistance of commercial quartz crystals in the range of 80 kc/s to 100 Mc/s. Information on the theory and operation of these instruments is given. Some data are shown indicating the results to be expected. A.

537.228.4

5426. The Kerr-effect and optical anistropy of hydrocarbons in the vapour state. STUART, H. A. AND V. SCHIESZL, S. *Ann. Phys., Lpz.* [*Folge* 6] **2** (*Nos* 7–8) 321–9 (1948) *In German.*—Experimental values for many hydrocarbons are given for the Kerr constant and it is concluded that normal hydrocarbons exist neither as a zig-zag chain nor a spherical ball, but in intermediate shape. Values of the anisotropy are obtained from both the Kerr constant and from the depolarization factors. The effect of double bonds on the anisotropy is discussed. The large Kerr constant of CH_4 is explained in terms of the zero point vibrations. D. H. W.

537.228.4

5427. On the relative measurement of Kerr constants. SCHERAGA, H. A., HOBBS, M. E. AND GROSS, P. M. *J. Opt. Soc. Amer.*, **39**, 410–11 (*May*, 1949).—Describes how relative measurements of Kerr constants can be made by using two cells in series with opposing optical rotations. Data are given for n benzene/chlorobenzene and for carbon-disulph chlorobenzene. J. I.

ELECTRIC CONDUCTION . CURRENTS 5

537.31

5428. A new electronic effect. PIERUCCI, Letter in *Nuovo Cim.*, **6**, 79–80 (*Jan.*, 1949) *In Italia* Immediately after cleavage a thin plate of n presents for a few minutes a highly enhanced c ductivity. There is both a surface and a bulk eff L

537.311.33 : 621.31

5429. On the crystal rectifiers. I. KOBAYASHI, *J. Phys. Soc. Japan*, **3**, 41–7 (*Jan.–Feb.*, 1948) *English.*—Rectification ratio against temp. for Si detectors gives a max. at ~ 60°C, whilst for some pyrites a kink occurs at ~ −60°C, but no defined n An explanation based on the tunnel effect of electr in the upper part of a blocking layer ~ 30 Å t provides a critical temp. at which rectificatio inversion occurs, the action being deduced to b function of layer thickness and the bulk conducti of the crystal. This leads to a qualitative explanat of the rectification inversion at different points the crystal surface. A. J. K.

537.311.33 : 621.314.63 : 621.383 : 621.315

5430. Electrical properties of solids. V. Se conductor rectifiers and photo-cells. VON MEYER W. A. *FIAT Rev. German Sci.* (1939–46) [*Off. Govt. Germany*] "*Physics of Solids, II*," 101–22 (19 *In German.*—Experiments by Klarmann on detection by chemical means of possible barrier lay in certain potential rectifier materials showed t barrier layers were formed on TiO_2 and NiO but on CdO and Cu_2O, although TiO_2 and Cu_2O w the only two materials that showed rectificat properties. Experiments on the photo-elec properties of CdS and CdSe, and of Se are record with results on every aspect of the behaviour of when used as a rectifying element, both volume a surface properties being treated. Schottky's 1 theory of dry rectification is described, together w some new ideas on the equivalent networks for rectifiers used on a.c. of various frequencies. Techni advances referred to include the various treatme which improve the rectifying properties of Se, the of Ag_2S films as photo-cells, a W/Si crystal detect and a better understanding of the optimum c ditions for the use of the Cu_2O rectifier. C. A.

537.311.33 : 621.315.59 : 621.314

5431. Physical principles involved in transis action. BARDEEN, J. AND BRATTAIN, W. H. *Ph Rev.*, **75**, 1208–25 (*April* 15, 1949).—A review of research carried out in American Universities a industrial firms which led to the development of crystal diodes and transistors. The operation of th devices depends on the emission of positive holes fr point-contacts under suitable conditions. Rec experiments have shown that these positive holes c diffuse through the bulk of the semi-conductor o

hall distances. The operating mechanism of ansistors is discussed, with special reference to its mp. dependence, the distance between the two oint contacts (emitter and collector) and the effect frequency. Transistors frequently exhibit current nplification ratios of 1–3 and sometimes higher. ositive feedback of collector current into the emitter rcuit is also observed. It can be increased by sistances in series with the base electrode. This edback can give rise to high power amplification, t also to instability. Voltage and current amplifica- on factors decrease with increasing separation of the oint contacts. The current amplification factor, and nce the power gain, rises slowly with temp. mplification is reduced at higher frequencies and ly a few units have positive gains above 10 Mc/s, ue to the finite time of transit for positive holes om the emitter to the collector. This transit time n be estimated from theory and agrees well with perimental results. Information on the conduction roperties of Ge in bulk is summarized. Electron onor *and* acceptor centres are thought to be present Ge specimens, though one type usually pre- ominates. At high temps., conduction is intrinsic, he activation energy being 0·75 eV. Ge diodes often hibit negative resistance characteristics, a pheno- enon which is not yet completely understood. The igh forward current normally observed is thought to e due to positive holes emitted from the point ontact and the rectifying barrier probably arises om the charge accumulated in surface levels. A rther consequence of these surface levels is to make he material a deficit semi-conductor in the immediate eighbourhood of the metallic contact. The experi- ental evidence for these theories is summarized. revious theories of rectification were based on the ssumption that only one type of current carrier is resent. Each contact of a transistor has properties milar to those of Ge crystal diodes. The current in he blocking direction has been shown to have 3 com- onents of different temp. dependence. The current ain of transistors can be accounted for by considering he space charges set up by the positive holes in the eighbourhood of the collector electrode. These pace charges modify the resistance of the barrier for he electrons which carry a substantial part of the urrent. H. K. H.

537.312.5

5432. Lead selenide photoconductive cells. MILNER, A. J. AND WATTS, B. N. Letter in *Nature, Lond.*, **163**, 22 (*Feb.* 26, 1949).—A new chemical method of reparing radiation sensitive PbSe cells continues the ork of Sommer in Germany. The spectral sensitivity rongly resembles that of PbSe cells produced by vaporation methods. Cells prepared by the chemical eposition method are relatively insensitive to incident adiation at normal room temps., but are good infra- ed detectors at very low temps. W. S.

537.312.5

5433. Optical sensitization of lead sulphide layers made without oxygen. GIBSON, A. F. Letter in *Nature, Lond.*, **163**, 321–2 (*Feb.* 26, 1949).—A PbS photocell has been prepared by the evaporation method without introducing O into the system as an impurity. The PbS is formed by evaporation in an atmosphere of S vapour. Photosensitization occurs when the PbS layer is kept at a low temp. and is irradiated by light of very high intensity. During preparation, the sensitivity of the cell rises to a max. and falls again to zero level. W. S.

537.312.5

5434. The efficiency of the selenium barrier-photocell when used as a converter of light into electrical energy. BILLIG, E. AND PLESSNER, K. W. *Phil. Mag.*, **40**, 568–72 (*May*, 1949).—An estimate is made of the order of magnitude of the efficiency to be expected, and measurements are made of the efficiency, using (*a*) monochromatic light, (*b*) daylight and incandescent light. The results are compared with those of Houston [Abstr. 1909 (1949)]. The lowest value, obtained with an incandescent source, is 10× Houston's highest. Reasons for this are suggested. L. S. G.

537.312.5 : 535.215

5435. The surface photoelectric effect. MAKINSON, R. E. B. *Phys. Rev.*, **75**, 1908–11 (*June* 15, 1949).—An expression is derived for the photoelectric current produced at the surface of a metal, the conduction electrons being supposed free and the potential barrier of arbitrary shape. The validity of the common assumption that the current arising from conduction electrons of a particular momentum can be expressed as the product of an excitation function and a transmission coeff. is examined. It is concluded that the assumption is in general valid. The production in the photoelectric current of beat frequencies between spectral lines is also briefly discussed. A.

537.312.62

5436. Theory of superconductivity. CHENG, K. C. Letter in *Nature, Lond.*, **163**, 247 (*Feb.* 12, 1949).—The criterion by Born and Cheng [Abstr. 3343 (1948)] that metals become superconductive if a set of corners of a Brillouin zone is lying very near the Fermi surface affords an explanation of the fact that superconducting elements lie exclusively in two columns of the periodic table. H. L.

537.312.62

5437. Variation of the superconducting characteristics of tantalum on saturating it with hydrogen. GOLIK, V. R., LAZAREV, B. G. AND KHOTKEVICH, V. I. *J. Exp. Theor. Phys., USSR*, **19**, 202–6 (*March*, 1949) *In Russian.*—The saturation with H was obtained electrolytically and the variation observed consisted in a considerable widening of the temperature and magnetic transition intervals. At high degrees of saturation super-conductivity does not occur down to a temperature of 1·85°K. The reversibility of this process when the specimen is tempered is shown, and the possibility of compounds being formed is discussed. B. F. K.

537.312.62

5438. On the existence of an electric field in superconductors. MAKIEJ, B. *Acta Phys. Polon.*, **9** (*Nos* 2–4) 141–7 (1947–48) *In English.*—By a generalization of Ohm's law and its application to the electric current in superconductors the fundamental laws of electrodynamics of superconductivity are deduced by purely formal analogy with the equations of motion of a free

charge in an electromagnetic field. For stationary currents the condition $\vec{E} + (\vec{J} \times \vec{H})/nec$ (where n is the number of superconductive electrons per cm³) asserts that there exist in superconductors an electric field acting upon the superconduction electrons but producing no Joule's heat, as its activity $(\vec{J} \cdot \vec{E}) = 0$. By a train of thought starting from Hamilton's principle the electric field is found to derive from an electric polarization inside the superconductors. The appearance of an electric polarization may be traced to a spin coupling of the electrons due to the existence of exchange forces. A calculation of the number of electrons worked out for a simplified model of a superconductor leads to a fairly good agreement with experiment. A.

537.312.62

5439. Perfect conductivity and perfect diamagnetism. MIKURA, Z. *Proc. Phys.-Math. Soc. Japan*, **24**, 899–914 (1942) *In English.*—It is stated that the electric and magnetic properties of a superconductor may be assigned to the behaviour of an assembly of classical, perfectly free electrons. Ohm's law is extended to the case of infinite conductivity, starting from Boltzmann's equation of state. It is also shown that the disappearance of the Hall effect in a superconductor is not contradictory to the free electron model. S. C. A. P.

537.312.62

5440. Non-linear extension of the London's theory. KOPPE, H. *Z. Naturforsch.*, **4a**, 74–5 (*April*, 1949) *In German.*—To take account of the characteristic current density associated with the spontaneous current threads of Heisenberg's theory, a modification of London's equation is proposed which leads to an increase of the penetration depth of the magnetic field into a superconductor with the field strength. This effect should become rapidly more marked as the temperature is lowered, in view of the falling off with temperature of Heisenberg's spontaneous current density. D. S.

537.312.62 : 532.51

5441. The hydrodynamic equations of a superconducting liquid. SOROKIN, V. S. *J. Exp. Theor. Phys., USSR*, **19**, 553–7 (*June*, 1949) *In Russian.*—The time derivative of F. and H. London's equation [Abstr. 1797 (1935)] relating the magnetic field in a superconductor to the curl of the current density is derived from the hydrodynamics of a non-viscous electronic fluid. It is then shown that the equation itself can be derived by a suitable form of the variation principle, although justification for the procedure is not provided by macroscopic considerations. D. S.

537.312.62 : 536.21

5442. Thermal conductivity of superconductors. HULM, J. K. *Nature, Lond.*, **163**, 368–9 (*March* 5, 1949).—Measurements of thermal conductivity K_s and K_n in the superconducting and normal states of pure Sn, alloys of Sn and up to 4% Hg, and pure Ta have been made by a new method in which temp. differences of only 0·01°K are used. The ratio K_s/K_n as a function of temp. is the same for pure Sn and the alloy with 0·033% Hg; the increase of the ratio for higher Hg contents is attributed to the effect of lattice conductivity. The curve for Ta is qualitatively similar to that for Sn and both agree approximately with a prediction by Heisenberg [Abstr. 2 (1949)]. D.

537.364 : 539.15

5443. On the production of electromotive forces centrifugation of electrolytes and its application to separation of isotopes. SALCEDO, R. *An. Real. S Esp. Fis. y Quim*, **44**, 251–68 (*March–April*, 1948) *Spanish.*—The author calculates the e.m.f. arisi from the concentration changes which are set up an electrolyte placed in a centrifuge. This e.m.f. independent of the absolute concentration of electrolyte but depends on its molecular weig Next an electrolyte is considered which contains t isotopes and is placed in a centrifuge provided w electrodes near the centre and near the periphe The author believes that the lighter and heav isotopes are deposited in a pure state at the inner a outer electrodes respectively, if a potential is appli that lies between the e.m.f. values characteristic the single isotopes. H.

ELECTRIC DISCHARGES 537.52

537.523 : 537.525

5444. Afterglow phenomena in argon–nitrogen mi tures at pressures close to atmospheric. JENKINS, H. G BOWTELL, J. N. AND STRONG, R. W. Letter *Nature, Lond.*, **163**, 401–2 (*March* 12, 1949).—D charges initiated by a Tesla transformer in 600 mm of A–N (8% N) give afterglows in which the gre O line (5 577 Å) is visible. The amount of O was le than 4×10^{-6}. Emission in the afterglow of a gre band in the region 5 600–5 400 Å accompanies t line 5 577 Å. J. D.

537.523

5445. A contribution to the oscillographic study corona currents in negative point/plane gaps. PERRI F. *C.R. Acad. Sci., Paris*, **228**, 477–8 (*Feb.* 7, 194 *In French.*—In order to avoid difficulties due to t variations in recurrence rate of corona pulses at given gap voltage, etc., the amplified corona pulses a fed to a series RC circuit. The voltages develop across R and C are then supplied to each of the t pairs of deflector plates of a cathode-ray oscillograp Recurrence rates may then be found by the suitab use of a standard oscillator. J. D.

537.523.4 : 537.525

5446. Search for the transition of streamer Townsend form of spark in air. FISHER, L. H. AN BEDERSON, B. Letter in *Phys. Rev.*, **75**, 1615 (*May* 1 1949).—Formative time lags in air were determin over the press. range 20–760 mm Hg, using a plan parallel gap of 1 cm. The average formative ti lags for 0·2% overvoltage varied from ~2 to 8 μs over the above press. range with a maximum ~11 μsec at $p \sim 450$ mm Hg. The results do n enable streamer and Townsend mechanisms to separated. J. D.

537.523.5 : 621.3.014.3

5447. Characteristics of the crater of the hig intensity carbon arc. FRANCIS, V. J., HAWKINS, F.

ND WILLOUGHBY, A. H. *Phil. Mag.*, **40**, 546–60 *May*, 1949).—The properties studied (experimentally) re the rate of burn of the positive C with respect to he effects of external oxidation and internal evapora- on, the crater diameter and depth, the arc voltage nd the axial candles. A theory of the operation of he high intensity arc is suggested and the experiments ive reasonable support to this. The positive carbons sed had external diameters from 16 mm to 30 mm nd core sizes ranging from 7 mm to 18 mm. All ores had the same chemical composition: 40 parts f amorphous C to 60 parts of cerium fluoride. L. S. G.

537.523.74

5448. Theory of plasma oscillations. A. Origin of medium-like behavior. BOHM, D. AND GROSS, E. P. *Phys. Rev.*, **75**, 1851–64 (*June* 15, 1949).—A theory of electron oscillations of an unbounded plasma of uniform ion density is developed, taking into account he effects of random thermal motions, but neglecting collisions. The first problem considered is that of finding the frequencies at which a plasma can undergo organized steady-state oscillations of small enough amplitude so that a linear approximation applies. It is found that long wavelength oscillations of plasmas with a Maxwell distribution of electron velocities are characterized by the steady-state dispersion relation $\omega^2 = \omega_P^2 + (3\kappa T/m)(2\pi/\lambda)^2$. Here ω_P is the plasma frequency, T the absolute temp. of the electron gas, λ the wavelength, and ω the angular frequency of oscillation. It is also shown that organized oscillations of wavelengths $<$ the Debye length for the electron gas are not possible. The theory is then extended to describe the processes by which oscillations are set up. It is found that, for a given wavelength, a plasma can oscillate with arbitrary frequency, but that those frequencies not given by the steady-state dispersion relation describe motions in which, after some time, there is no contribution to macroscopic averages. These additional frequencies lead asymptotically only to microscopic fluctuations of the charge density about the organized oscillation of the plasma. In this way, one can describe the manner in which the system develops organized behaviour. The treatment is then applied to large steady-state oscillations for which the equations are non-linear. One obtains solutions in which particles close to the wave velocity are trapped in the trough of the potential, oscillating back and forth about a mean velocity equal to that of the wave. One can also obtain non-linear travelling pulse solutions in which a group of particles, moving as a pulse, creates a reaction on the surrounding charge, which traps the particles and holds them together. A.

537.523.74

5449. Theory of plasma oscillations. B. Excitation and damping of oscillations. BOHM, D. AND GROSS, E. P. *Phys. Rev.*, **75**, 1864–76 (*June* 15, 1949).—The theory of electron oscillations of an unbounded plasma is extended to take into account the effects of collisions and special groups of particles having well-defined ranges of velocities. It is found that as a result of collisions a wave tends to be damped in a time of the order of the mean time between collisions. If beams of sharply defined velocity or groups of particles far above mean thermal speeds are present, however, they introduce a tendency toward instability so that small oscillations grow until limited by effects not taken into account in the linear approximation. An estimate is made of the steady-state amplitude for plasma oscillations in which excitation occurs because of a peak at high velocities in the electron velocity distribution, and in which the main damping arises from collisions. It is also found that in variable density plasmas, waves moving in the direction of decreasing plasma density show even stronger instability. In absence of plasma oscillations, any beam of well-defined velocity is scattered by the individual plasma electrons acting at random, but, when all particles act in unison in the form of a plasma oscillation, the scattering can become much greater. Because of the instability of the plasma when special beams are present, the beams are scattered by the oscillations which they produce. It is suggested that this type of instability can explain the results of Langmuir, which show that beams of electrons traversing a plasma are scattered much more rapidly than can be accounted for by random collisions alone. It is also suggested that this type of instability may be responsible for radio noises received from the sun's atmosphere and from interstellar space. A.

537.525

5450. Some aspects of the glow discharge between coaxial cylinders in the presence of a non-homogeneous axial magnetic field. SOMERVILLE, J. M., CHAMPION, K. S. W. AND BIGG, E. K. *Aust. J. Sci. Res. A*, **1**, 400–11 (*Dec.*, 1948).—The characteristics of the discharge in air are described. With the outer cylinder as cathode the discharge is narrow and takes place near the position of max. magnetic field. If the cathode is cut transversely into halves dividing the discharge there may be a negative increment resistance between these halves. This negative resistance may be used as the basis of an oscillator working with an efficiency of about 70% up to frequencies of about 100 kc/s. A.

537.529 : 621.3.015.5 : 621.319.4

5451. The energy dissipated by discharges. PELZER, H. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. L/T*207) 3 *pp.* (1948).—It is pointed out that the expressions derived by Austen and Hackett [*J. Instn Elect. Engrs*, **91**, 298 (1944)] for the energy dissipated by discharges in voids of the dielectric in a capacitor connected to an a.c. supply, are being wrongly used. The expressions are re-stated, and an idealized example is given as illustration. E. R.

537.529 : 621.315.61.015.5

5452. Thermal breakdown with internal defects. WHITEHEAD, S. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. L/T*193) 13 *pp.* (1948).—Thermal instability is unlikely to occur in a dielectric in the neighbourhood of defects due to a local concentration of field or of heat flow. The defect itself must generate heat to cause instability. Possible sources of heat are considered in the case of power and radio frequencies. Propagation of a simple cylindrical or thread-like breakdown path by thermal instability alone requires special conditions, but may readily occur with tree-like breakdown paths. E. R.

X-RAYS 537.531

537.531 : 535.3

5453. A correction to the diameter measurement of diffuse X-ray diffraction rings. FINCH, L. G. Letter in *Nature, Lond.*, **163**, 402–3 (*March* 12, 1949).—By representing the observed lines as the sum of the two curves of the form $y = \mathrm{sech}^2 hx$, h being typical of the degree of broadening, a relationship is determined between the width at ½ max. intensity and the deviation between the $K\alpha_1$ and the apparent peak. Peak deviations found in this way with steel have been equivalent to 0·04% in lattice parameter. A. E. DE B.

537.531 : 535.3 : 614.8

5454. Broad and narrow beam attenuation of 500–1 400 kV X-rays in lead and concrete. WYCKOFF, H. O., KENNEDY, R. J. AND BRADFORD, W. R. *Nucleonics*, **3** (*No.* 5) 62–70 (*Nov.*, 1948).—X-rays from a target of small dimensions were passed through defining diaphragms and through various absorbers, and were detected with an air-filled ionization chamber. The limiting geometrical conditions were: (*a*) such that the chamber responded only to radiation coming directly from the target; (*b*) such that increase of the area of absorber irradiated led to no increase of ionization current. Absorption curves for various energies are given for these extremes and for two intermediate widths of beam. The use of the broad beam curves, which exhibit the least attenuation, is recommended except when geometrical conditions are very well defined. A. P. F.

537.531 : 535.313 : 548.734

5455. X-ray optics with doubly curved natural crystals. WILSDORF, H. *Naturwiss.*, **35** (*No.* 10) 313–14 (1948) *In German.*—For image formation the reflecting crystal must be given a double curvature, i.e. must be bent to form a non-developable surface. This has been achieved with mica (elastic deformation) and rock salt (plastic deformation), and focused images of a wire gauze obtained. By imaging the focus of an X-ray tube on a film and interposing a specimen, monochromatic powder and single-crystal photographs can be obtained in a few minutes. A. J. C. W.

537.531 : 535.339 : 548.73

5456. A new bent-crystal X-ray monochromator. WOOSTER, W. A., RAMACHANDRAN, G. N. AND LANG, A. *J. Sci. Instrum. Phys. Ind.*, **26**, 156–7 (*May*, 1949).

537.531 : 535.4

5457. Inter-particle interference effects in the small angle X-ray scattering from fine powders. LUND, L. H. AND VINEYARD, G. H. *J. Appl. Phys.*, **20**, 593–7 (*June*, 1949).—Simple formulae for calculating the small angle X-ray scattering from aggregates of identical spherical particles, taking into account the interference between different particles, are given. The case of independent clumps of particles and the case of a more general arrangement describable by a radial density function are considered. Calculated curves of scattered intensity *v.* angle for likely arrangements of both types are presented. The assumption that each particle scatters independently is seen to be a poor approximation whenever there is a significant amount of clumping or whenever the average density of the sample is as much as ½ of the density corresponding to close packing. Estimates of particle size from the small angle scattering are shown to be seriously affected.

537.531 : 535.42 : 53

5458. Scattering of X-rays in an acetone–wa solution. DANILOV, V. I., ZUBKO, A. M. AND DA LOVA, A. I. *J. Exp. Theor. Phys., USSR*, **19**, 242- (*March*, 1949) *In Russian.*—There are considera differences in the results of diffraction studies various authors of this solution, as well as of co parable solutions (e.g. benzol–cyclohexane), and t mainly concern the question whether or not a sup position of the patterns due to the single compone takes place. The fact that the first maxima of eit component appeared separately, led Ward [Abs 1777 (1934)], and after him Mokhov [*Dnepropetro Univ. Publ.* (1938)], to conclude that the superpositi principle did not apply unrestrictedly. A later che on Ward's data by Eisenstein and Gingrich [Abs 2155 (1942)] proved these to be incorrect, as the la authors found superposition already for the fi maximum. The paper gives a detailed report on repetition of Mokhov's experiments in monochroma radiation, in order to clarify the question whether unambiguous structural analysis of solutions possible at all in spite of the well-known "washe out" appearance of the diffraction pictures. T results are discussed, referring to work of many mo authors on the subject, and to the individual diffra tion curves of the components, and it is shown th the ratio $(\sin\theta)/\lambda$ decides whether or not sup position takes place. Up to a value of 0·2 of t ratio, there is no superposition, whereas it alwa occurs above this value. The conclusion reached that in solutions there are always small regions of structure similar to the structure of the individu components. This is also suggested by a comparis with Bernal and Fowler's hypothesis on the structu of water [Abstr. 3951 (1933)], especially by t quadruple co-ordination of the molecules assum by this theory. B. F.

537.531 : 621.386

5459. A theoretical comparison of the performan of stationary-target crystallographic X-ray tub operating on alternating and direct voltages. WITT R. AND WOOD, P. Letter in *Nature, Lond.*, **16** 323–4 (*Feb.* 26, 1949).—It has been suggested that a normally self-rectifying crystallographic X-ray tu is operated on d.c. instead of a.c., it should be possib approximately to double the power input to the tu and therefore to increase the X-ray output. Theoretica conclusions show that the increase in intensity obtaine by operating a stationary target tube on a d.c. h. supply as opposed to an a.c. supply is approximate 40%. This advantage is, however, outweighed by th additional expense and maintenance of d.c. and b the fact that the ratio of characteristic to whi radiation is practically unchanged. R. H. F.

CATHODE RAYS . POSITIVE RAYS 537.533/.53

537.53

5460. On the classical radiation of accelerate electrons. SCHWINGER, J. *Phys. Rev.*, **75**, 1912–2

June 15, 1949).—This paper is concerned with the properties of the radiation from a high energy accelerated electron, as recently observed in the General Electric synchrotron. An elementary derivation of the total rate of radiation is first presented, based on Larmor's formula for a slowly moving electron, and arguments of relativistic invariance. An expression for the instantaneous power radiated by an electron moving along an arbitrary, prescribed path is then constructed. By casting this result into various forms, one obtains the angular distribution, the spectral distribution, or the combined angular and spectral distributions of the radiation. The method is based on an examination of the rate at which the electron irreversibly transfers energy to the electromagnetic field, as determined by ½ the difference of retarded and advanced electric field intensities. Formulae are obtained for an arbitrary charge-current distribution and then specialized to a point charge. The total radiated power and its angular distribution are obtained for an arbitrary trajectory. It is found that the direction of motion is a strongly preferred direction of emission at high energies. The spectral distribution of the radiation depends upon the detailed motion over a time interval large compared to the period of the radiation. However, the narrow cone of radiation generated by an energetic electron indicates that only a small part of the trajectory is effective in producing radiation observed in a given direction, which also implies that very high frequencies are emitted. Accordingly, one evaluates the spectral and angular distributions of the high frequency radiation by an energetic electron, in their dependence upon the parameters characterizing the instantaneous orbit. The average spectral distribution, as observed in the synchrotron measurements, is obtained by averaging the electron energy over an acceleration cycle. The entire spectrum emitted by an electron moving with constant speed in a circular path is also discussed. Finally, it is observed that quantum effects will modify the classical results here obtained only at extraordinarily large energies. A.

537.533 : 621.385.032.21

5461. Transit-time deterioration of space-charge reduction of shot effect. MacDonald, D. K. C. *Phil. Mag.*, **40**, 561–8 (*May*, 1949).—The emission current from a thermionic or photo-electric cathode exhibits complete randomness; but when space charge is present there is less fluctuation, since a certain degree of order is introduced through the interaction of the electrons. If this current drifts for some distance a progressive disordering will re-establish itself. The magnitude of this disordering is calculated as a function of the drift time. The limiting case of extremely high frequencies and very small currents is examined separately. L. S. G.

537.533 : 621.385.2

5462. Retarding field current in a cylindrical diode. Bell, D. A. Letter in *Proc. Phys. Soc. B*, **62**, 334–5 (*May*, 1949).—Retarding field measurements on a cylindrical diode with very large anode-cathode radius ratio gave a temp. roughly twice the actual temp. A physical argument leading to the expectation $i = i_0 A \exp(-eV/2kT)$ for this case is given. [But cp. Schottky, *Phys. Z.*, **15**, 624–30 (1914), Abstr. 1588 (1914)]. A. H. W. B.

537.533/.534

5463. Further improvements in magnetic focusing. Kerwin, L. and Geoffrion, C. *Rev. Sci. Instrum.*, **20**, 381–4 (*June*, 1949).—The general theory of magnetic focusing in a plane developed in a previous paper [*Rev. Sci. Instrum.*, **20**, 36 (1949)] is extended to asymmetric cases. The general asymmetric case being developed, several particular examples are considered, including one which eliminates second-order aberrations, and requires a smaller magnet than the normal design. Methods of minimizing aberrations are discussed. A.

537.533/.534 : 621.384

5464. The development of the linear accelerator. Graffunder, W. *Helv. Phys. Acta*, **22** (*No.* 3) 233–60 (1949) *In German.*—A review article giving an outline of theory and design calculations. Bibliography of 32 refs.

537.533.3 : 518.5

5465. Plotting electron trajectories. Sander, K. F., Oatley, C. W. and Yates, J. G. *Nature, Lond.*, **163**, 403 (*March* 12, 1949).—A differential analyser [Abstr. 3888 (1939)] is coupled to the probes in an electrolytic tank, which feed in the electric field components. The double integral of the acceleration gives the displacement which is fed back to the probes. A check on a two-cylinder lens gave adequate agreement with numerical integration. The apparatus, which will shortly be described in detail, should be applicable to time-varying fields. J. C. E. J.

537.533.3 : 621.385.833

5466. Distortion-free electrostatic lenses. Mulvey, T. and Jacob, L. *Nature, Lond.*, **163**, 525–6 (*April* 2, 1949).—Measurement of distortion of electrostatic 3-aperture lenses, diameter and separation 4 mm. With thickness of central electrode < 1 mm strong pincushion distortion occurs, but it decreases with increasing thickness, eventually becoming barrel distortion. It is zero at 3 mm thickness of central electrode, when connected as a unipotential lens. The effect is attributed to the formation of separate lenses on each side of the thick central electrode; analogy is drawn with Hillier's results for 2 similar lenses a focal length apart [*J. Appl. Phys.*, **17**, 411 (1946)]. Curves are given of distortion against electrode separation with thickness/aperture ratio as parameter. J. C. E. J.

537.533.33 : 621.385.833

5467. The electron optics of the image convertor. I–II. Veith, W. *Rev. Sci., Paris*, **86**, 67–76 (*Jan.* 15, 1948) *In French.*—I. The electrostatic focusing in the image convertor is simply described. Numerous diagrams show the distribution of the equipotentials and the electron trajectories. Various types of convertors are compared and aberrations of the image and their causes are discussed. In Pt II a "corrected" electrostatic lens is described. It is of the aperture type; for theory see Glaser and Henneberg, *Z. tech. Phys.*, **16**, 222 (1935). L. S. G. (R)

537.533.7 : 621.384.6

5468. A new type of betatron without an iron yoke. Bierman, A. Letter in *Nature, Lond.*, **163**, 649–50 (*April* 23, 1949).—A 9 MeV betatron weighing only 50 kg is described. A 5 kg core of transformer

laminations is used to give the flux needed within the orbit and to give a field varying as $r^{-\frac{1}{2}}$ over the glass acceleration tube. Current from a 6·5 μF condenser at 50 kV is initiated by a spark gap. Owing to low inductance the frequency of resulting damped oscillations is high, 2·5 kc/s, and the energy gain per revolution is 240 eV. Peak intensity is high compared with conventional betatrons but only a few periods of oscillation per discharge and not more than 1 discharge/sec can be used. J. H. F.

537.533.72

5469. Spiral-form β-ray spectrometer. MIYAMOTO, G. *J. Phys.-Math. Soc. Japan*, **17**, 557–66 (1943).—The outline of the spectrometer designed for the measurement of β-ray spectra of weak radio-active nuclei emitting positive and negative electrons was described in a preceding paper [*Proc. Phys.-Math. Soc. Japan*, **24**, 676 (1942)]. Further experiments on the resolving power, etc., are reported here. The measurements were made with β-rays from RaB, ThB and thermoelectrons. The separation of positive and negative electrons are satisfactory, and the available solid angle is 5% of the total 4π, when the breadth of the spectrum has the resolving power of 5–6%. The characteristics of the meter were studied with thermoelectrons accelerated with 0–3 000 V. About 50% of the electrons reach the detector, when the breadth of the spectrum is kept at about 2% at its centre. Experiments were made also by varying the accelerating voltage in a definite magnetic field. It was ascertained that it can be used as a mass-spectrograph. S. C. A. P.

537.533.72 : 621.38

5470. Electron emission and electron flow. KNOLL, M. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] *Pt I*, **2**, 20–42 (1948) *In German.*—A general report on progress during the above period, under the following headings: Potential fields and path tracing; imaging theory; image aberrations; deflection and deflection errors; space charge effects; electron lenses; immersion lenses; deflection systems. A full bibliography of 101 items is given. A. H. W. B. (R)

537.533.74

5471. Inelastic scattering of low speed electrons from a copper single crystal. REICHERTZ, P. P. AND FARNSWORTH, H. E. *Phys. Rev.*, **75**, 1902–8 (*June* 15, 1949).—The energy distribution of inelastically scattered electrons from a (100) face of a Cu single crystal has been investigated by the electrostatic deflection method. Using normal incidence of the primary electrons, observations were made in the neighbourhood of two strong diffraction peaks in the (100) azimuth, one at 59·5 eV primary energy and colatitude angle 60°, and one at 114·5 eV and 40·5°. Discrete loss peaks were observed at about 3·0, 6·0, 12·3 and 20·0 eV energy loss with the intensities depending on both primary energy and colatitude angle. An excess of inelastic scattering occurs near the elastically scattered diffraction beams so that maxima are observed in the curves giving the intensity of inelastic scattering as a function of primary energy for constant values of energy loss. Near the 59·5 eV diffraction beam the maxima of the curves for different values of energy loss occur at a constant value of primary energy. This suggests that the inelas scattering takes place after diffraction, but the fa that the maxima occur at 56 eV instead of 59·5 is not understood. For inelastic scattering ne the 114·5 eV diffraction beam the results are co plex but are approximately explained by assumi (1) inelastic background scattering followed by d fraction, for energy losses below 10 eV, (2) the sa as (1) plus diffraction followed by inelastic backgrou scattering, for energy losses above 10 eV. Possit reasons are given for the fact that the maxima for t latter process occur 3·5 eV above the energy for t diffraction maximum.

537.533.

5472. The penetration of 17 MeV electrons. AGEN M. AND CHIOZZOTTO, M. *Nuovo Cim.*, **6**, 81– (*March*, 1949) *In Italian.*—The electrons were pr duced in Al by the 17·6 MeV γ-rays of Li. T absorption curves in paraffin, Al, Fe, Cd, Pb sh long tails, of intensity of the order of 1% that of t incident radiation, partly due to secondary processe The penetration decreases regularly with the increa of the atomic number of the absorber. L.

537.533.8 : 539.1

High-energy electron accelerators as pulsed neutr sources. *See Abstr.* 5685

537.5

5473. The proton microscope. MAGNAN, *Nucleonics*, **4**, 52–66 (*April*, 1949).—The simple theo of electrostatic lens systems is developed, with speci ref. to aberrations. It is pointed out that very sm ellipticity in the central ring of a 3-electrode lens m cause serious aberrations. The practical details design and construction are given for a 3-lens prot microscope of an experimental type (magnificati $\sim$ 80 000). It is shown that one may hope to achie an ultimate resolution of $\sim 10^{-8}$ cm, although t uncertainty principle will preclude a study of atom structure. A. P.

537.5

5474. A resonance effect in the synchrotr COURANT, E. D. *J. Appl. Phys.*, **20**, 611–16 (*Jun* 1949).—The effect of the resonance occurring $n = -d(\log H)/d(\log r) = \frac{3}{4}$ between the second ha monic of the frequency of radial oscillations and t frequency of revolution of the particles in a sync rotron is analysed. It is shown that this resonan will lead to an increase in the amplitude of the radi oscillations if the first Fourier coefficient of t azimuthal variation of n is too large. The effect m occur even if the value of n at the equilibrium orb is $\neq \frac{3}{4}$, because the orbit will drift back and for periodically due to the phase oscillations and m cross the place where $n = \frac{3}{4}$. A criterion is deriv for the condition that the increase in the amplitu of the oscillations per unit time due to this resonan be $<$ the decrease in the amplitude due to the ma netic damping, i.e. that there be a net damping effe It turns out that this condition reduces to the requir ment that the first Fourier component of the azimuth inhomogeneities of the magnetic field be $\ll$ abo 10^{-3}. If this condition is not satisfied the resonan effect will reduce the intensity of the beam unless t equilibrium value of n is sufficiently far from $\frac{3}{4}$.

537.534

5475. Design for a metal mass spectrometer tube. [ICKAM, W. M. *Rev. Sci. Instrum.*, **20**, 472–4 (*July*, 949).—A 90° sector type mass spectrometer tube ıade of Monel is described. The design is such that ıe electrode assemblies and analyser section are asily removable without destroying the slit align-ıent. A double gasket arrangement is used for aking the necessary high vacuum seals. The tube an be operated at an elevated temp. with no cold ots which is particularly desirable for degassing and r studying samples which have low vapour pressures. peration of the analyser section at any desired otential with respect to ground is permitted. A.

537.534 : 539.172.1

5476. Instrumentation for nuclear studies with xternally focused deuteron beam from ten-Mev yclotron. CURTIS, B. R., FOWLER, J. L. AND ROSEN, . *Rev. Sci. Instrum.*, **20**, 388–93 (*June*, 1949).—A eam of 10 MeV deuterons of about $\frac{1}{2}$ μA has been ocused on an area $\frac{1}{4}$ in. in diameter at the centre of 2 ft diameter reaction chamber 15 ft away from the yclotron. In the centre of the reaction chamber a as target is supported with side ports so constructed at nuclear reaction products from the gas can be ounted by a proportional counter mounted at the eriphery of the chamber. The counter can be otated through a Wilson seal to make any angle with ıe beam in the horizontal plane. At the exit of the action chamber a Faraday cup is supported. This an be removed to allow the beam to pass between ıe poles of an analysing magnet for energy measure-ents. Tests with charged particle detectors such as proportional counter or photographic plates show ıe background to be sufficiently low to allow good solution of the products from the *d-d* reactions. sing the *d-d* reaction as a neutron source, back-round neutrons above 12 MeV are only about 10%. lowever, the background neutrons above 1 MeV mount to about 25 times the neutrons from the *-d* reactions. A.

537.534 : 621.317.31

5477. An instrument for the measurement and time ntegration of small voltages and currents. LEWIS, A. D. AND CLARK, A. C. *J. Sci. Instrum. Phys. Ind.*, 6, 80–4 (*March*, 1949).—Used for measuring cyclo-on beam current to an insulated target.

537.534 : 621.384

5478. Design of an improved-yield discharge tube. ACHNER, J. *Nucleonics*, **3** (*No.* 6) 43–51 (*Dec.*, 948).—Complete translated text of the paper bstracted in Abstr. 1457 B (1948). Some errata are ointed out in *Nucleonics*, **4**, 83 (*April*, 1949).

537.534.74

5479. "Bremsung" of protons. ARAKI, G. *J. Phys.-Math. Soc. Japan*, **16**, 79 (1942).—The scattering of igh energy protons by atomic nuclei, by which rocess mesons or photons are emitted, has been alculated by the method of Williams and Weizsäcker n the pseudoscalar field theory, and the results are riefly shown. S. C. A. P.

537.534.74

5480. Inelastic scattering of protons by magnesium nd aluminium. RHODERICK, E. H. Letter in *Nature*, *Lond.*, **163**, 848–9 (*May* 28, 1949).—Protons of 4·5 MeV initial energy were observed at various angles after scattering in foils of Mg or Al. Excited states of Mg were found at $1{\cdot}36 \pm 0{\cdot}03$ and $1{\cdot}82 \pm 0{\cdot}04$ MeV above ground state (possibly different isotopes involved). Levels of Al were found at $\sim 0{\cdot}75, 0{\cdot}97 \pm 0{\cdot}02$ and $2{\cdot}15 \pm 0{\cdot}05$ MeV; correlation with γ-rays following β-decay of Mg^{27} [Abstr. 1899 (1948)] is slight. The variations of inelastic scattering yield with incident proton energy suggested compound nucleus formation rather than excitation by Coulomb interaction. Approx. cross-sections for excitation are given. A. P. F.

537.534.74

5481. Angular distribution in the proton–proton scattering at 14·5 MeV. TIOMNO, J. *An. Acad. Brasil. Cienc.*, **21** (*No.* 1) 55–63 (1949) *In Portuguese.*—Calculations were carried out in Born's approximation with the vector, pseudoscalar and symmetrical (Schwinger) theory. Only the last gives results compatible with experimental data. L. P.

537.534.9

5482. Ionization and charge exchange by fast ions of hydrogen and helium. KEENE, J. P. *Phil. Mag.*, **40**, 369–85 (*April*, 1949).—Experiments involving collisions of H^+, H_2^+ and He^+ ions with H_2 and He in the energy range 3–35 keV are described. An accurate method for measuring charge exchange and ionization cross-sections is presented. Values for the cross-sections are exhibited graphically, and a method for measuring e/m for secondary ions is discussed. L. S. G.

DISCHARGE TUBES . COUNTERS 537.54

537.542

5483. How the Geiger–Müller counter works. FESTA, C. *Ann. Geofis.*, **2**, 74–91 (*Jan.*, 1949) *In Italian.*—A critical review of recent research. L. P.

537.542

5484. On the construction of Geiger–Müller counters in metal. LESAGE, M., ROGOZINSKI, A. AND VOISIN, A. *J. Phys. Radium*, **10**, 212–14 (*June*, 1949) *In French.*—Describes an "all-metal" type of Geiger counter suitable for general cosmic ray work. Insulation is provided by the use of glass/metal seals and a detailed scale diagram is given, showing electrode mountings, etc. Filling and cleaning processes are described. Considerable reliability is claimed for the final product. J. D. C.

537.542

5485. The scintillation counter. COLTMAN, J. W. *Proc. Inst. Radio Engrs*, **37**, 671–82 (*June*, 1949).—A review of the present state of knowledge regarding the characteristics of the counter and the details of its operation. A.

537.542 : 621.383

5486. Performance of 931-A type multiplier in a scintillation counter. MORTON, G. A. AND MITCHELL, J. A. *RCA Rev.*, **9**, 632–42 (*Dec.*, 1948).—The scintillation type nuclear radiation detector depends

for its operation on the conversion into an electrical pulse of the light flash produced by a suitable phosphor crystal when the latter absorbs a nuclear particle such as an α- β- or γ-ray, or neutron. The conversion of the light flash is effected by means of a secondary emission multiplier. The results are given of the examination of a number of RCA 931A type multipliers for their suitability for this application. The properties of interest are (1) the pulse performance of the multiplier under conditions such that individual, or at most only a few, photoelectrons from the photocathode contribute to the pulse; and (2) the number and distribution of spurious pulses generated by the multiplier in darkness. The pulse height distribution at the output of a multiplier, due to pulses from individual photoelectrons, is considerably broader than would be expected from a Poisson's distribution of secondary electrons at each stage. Distribution curves are given. In complete darkness a good multiplier at room temperature is found to produce 300 to 600 pulses/sec with a height $\geqslant$ the charge of an electron $\times$ the average gain of the tube. Curves are given of dark current pulse distributions, the effect of temperature, shield potentials, etc. A.

537.542 : 621.383

5487. The characteristics of electronic photomultipliers used as detectors of scintillations. AGENO, M., CHIOZZOTTO, M. AND QUERZOLI, R. *Nuovo Cim.*, **6**, 217–27 (*May*, 1949) *In Italian.*—A systematic investigation of this device, particularly under small light intensity. Details and curves given should be helpful to anybody contemplating the construction of such an instrument. L. P.

537.542 : 539.164.9 : 535.376

Luminescence under alpha-radiation. *See Abstr.* 5365

537.542

5488. A sodium photon counter. ROIKH, I. L. Letter in *J. Exp. Theor. Phys., USSR*, **19**, 269–70 (*March*, 1949) *In Russian.*—A counter with a Na photocathode for visible light is described. The photocathode inside the envelope is obtained by electrolysis through the glass. The sensitivity was of a very high order after processing by a glow discharge, but the stability was unsatisfactory. Interesting characteristics of this type of counter are the small number of "dark" impulses and the existence of a relatively wide plateau of $\sim$ 100 V. B. F. K.

537.542 : 539.164

5489. Determination of energy of single alpha-particles from change in conductivity of cadmium sulphide crystals. KALLMANN, H. AND WARMINSKY, R. *Research, Lond.*, **2**, 389–92 (*Aug.*, 1949).—In continuation of previous work [Abstr. 2084 (1949)] on the conductivity of cadmium sulphide crystals, the behaviour of very weakly activated crystals excited by single α-particles is investigated in detail. It is found that the pulses of current in these crystals are $\propto$ the energy of the absorbed particles. This property, as well as the short decay period of the pulses, makes the crystals suitable for quantitative measurements. Such crystals have a number of advantages over an ionization chamber; in particular, the whole arrangement is considerably simpler. A.

537.5

5490. The crystal counter. MILATZ, J. M. *Ned. T. Natuurk.*, **15**, 24–32 (*Feb.*, 1949) *In Dutch.* A discussion of the limitations of the G–M coun and the Wilson chamber with linear amplifier followed by an illustrated description of a coun using an AgCl crystal between the electrodes (pla capacitor) with *RC* differentiating circuits (*RC* 10^{-3} sec) and c.r.o., which registers the energies both α- and β-particles. The photoelectric p perties of the AgCl crystal, and of other ideochroma crystals are compared with those of allochroma crystals, NaCl and certain kinds of diamond. Id chromatic crystals give a current impulse $\propto$ ene of both α- and β-particles. J. A.

537.

5491. Crystal counters. I. HOFSTADTER, *Nucleonics*, **4**, 2–27 (*April*, 1949).—The basic the of electron collection in a crystal is discussed, w special reference to (*a*) the average penetration of electron into a crystal, which determines the size induced pulse recorded, and (*b*) polarization effe which may cause a reduction of pulse size afte few million counts have been recorded. The prepa tion and handling of possible counting materi (diamond, CdS, Ag and Tl halides, solid and liquid are described, and a brief description is given vacuum and electronic equipment suitable observing and recording the pulses produced α-, β- and γ-radiations in crystals at vari temperatures. (57 refs.). A. P

537.

5492. A cloud chamber of light weight for ball flights. SHUTT, R. P., JOHNSON, A. L. AND THORNDI A. M. *Rev. Sci. Instrum.*, **20**, 398–400 (*June*, 1949) Some constructional details of cloud chambers u for balloon flights are described. Details are gi on the fabrication of transparent plastic front wa and cylinders for the cloud chambers. A relativ large number of bicycle spokes is used for hold the chamber together, thus distributing mate stresses, enabling Al parts of the cloud chamber be quite light. The back and front walls of the clo chambers are somewhat spherically curved, result in considerable reduction of material thickness By the same means a piece of slightly curved me gauze is sufficient to limit the motion of the rub diaphragm in the compressed position. A mechani used for adjusting expansion ratios can be remo before a balloon flight. Gas and liquid can inserted through bicycle valves. The cloud chamb are 12 in. in diameter, 3½ in deep, and weigh appro mately 6 lb.

537.

5493. A 22-inch Wilson cloud chamber in a magne field of 21 700 gauss. POWELL, W. M. *Rev. S Instrum.*, **20**, 403–7 (*June*, 1949).—The magnet pulsed in synchronism with the 184 in Berke cyclotron and can be operated with a steady field 10 000 gauss. The use of the instrument for identi ing light atoms is discussed briefly.

537.

5494. A counter controllable high pressure cl chamber. VALLEY, G. E. AND VITALE, J. A. *R Sci. Instrum.*, **20**, 411–23 (*June*, 1949).—A h

essure cloud chamber is described which is so signed as to be as easily counter controlled as an dinary cloud chamber. The instrument is fitted ith a magnet capable of producing a field of approx.) 000 gauss continuously. It is mounted in a trailer nd can be readily transported to mountain sites. A.

537.542

495. The ten-channel electrostatic pulse analyser. ATKINS, D. A. *Rev. Sci. Instrum.*, **20**, 495–9 (*July*, 949).—A ten-channel pulse height discriminator using beam deflection tube is described. The instrument rovides 1 V channels and has a high degree of ability. Essential circuits are given so that the nalyser may be readily duplicated. Performance nd limitations are discussed. A.

537.542 : 621.318.572

496. Differential counting with reversible decade ounting circuits. MARTENS, F. H. *Rev. Sci. Instrum.*, 0, 424–5 (*June*, 1949).—Three circuits were designed nd built to apply a reversible decade counting circuit o the direct measurement of the difference in the ounting rate from two counter tube telescopes used cosmic-ray research. The circuits are equally pplicable to the direct measurement of the difference n the strength of two radioactive samples. An input ircuit prevents two pulses from the Geiger tubes rom arriving simultaneously at the first ring-of-10. driving circuit switches and shapes the pulses for orrect bi-directional operation of the ring-of-10. coupling circuit permits two decade rings to be perated in cascade, giving a differential electronic cale of 100. A.

537.542 : 621.318.572

497. Analysis of scale units. BUYS, W. L. *Nucleonics*, **3** (*No.* 5) 49–61 (*Nov.*, 1948).—The ransient conditions in a scale-of-2 circuit are treated n detail. The relative merits of diode and capacitance oupling for triggering the circuit are discussed. Questions of stability and resolving time are con-idered and other general matters affecting the design re briefly mentioned. A. P. F.

537.542 : 621.318.572

498. An investigation of various coincidence ixing stages. STOLL, P., WALTER, M. AND ZÜNTI, W. *Helv. Phys. Acta*, **21** (*Nos* 3–4) 77–9 (1948) *In German.* –The performances of the cathode-mixing stage Kurshan, Abstr. 935 B (1948)], the diode mixing tage [Howland, Schroeder and Shipman, Abstr. 565 (1947)], and the Rossi stage have been studied nd are described. R. W. P. (R)

537.542 : 621.318.572 : 621.317.755

499. A new apparatus for counting down of impulses. IMONYI, K. *Publ. Univ. Tech. Sci., Budapest* (*No.* 3) 77–8 (1948) *In German.*—This apparatus, which is ntended to avoid the need for frequency-dividing hains, such as several multi-vibrator stages, for G–M ounters and the like, consists of a specially-con-tructed c.r.t. The final anode is divided into 10 or nore square segments in a row in the *X*-co-ordinate, nd all, except the last, are coupled together externally o a resistance network which is connected to one of he *X*-deflection plates. The last segment is con-ected to the others through another network and lso to one of the *Y*-plates. The c.r.t. is so designed and the potentials so set that at the start the beam is directed at the 1st segment. An impulse applied to the 2nd *X*-plate alters the anode-cathode voltage distribution and so affects the 1st *X*-plate that the beam is deflected on to the 2nd segment. Subsequent impulses deflect the beam further across the row until it strikes the last, whereupon the voltages on *X*- and *Y*-plates are so affected that the beam is deflected back, without passing across the other segments, to the 1st segment. The frequency-divided output is apparently taken from the *Y*-deflection circuit. The c.r.t. is said to have possibilities as an oscillator.

H. G. M. S.

537.542 : 539.16.08

5500. A precision automatic electrometer. SEATON, N. T. *Rev. Sci. Instrum.*, **20**, 500–3 (*July*, 1949).—A triple-range portable electrometer suitable for the precision measurement of currents of the order 10^{-11} to 10^{-14} A is described. Current is measured in terms of the automatically registered time interval required to charge a condenser up to a certain voltage. The use of negative feedback and special operating conditions for the input FP-54 Pliotron allow current to be simply determined to within 0·1%. Radio-type dry batteries, which operate the instrument completely except for a timer, are contained within the amplifier and will last at least 250 hours. A.

IONIZATION . THERMIONICS 537.56/.58

537.56 : 621.315.611

5501. Ionization chamber technique. GARTON, C. G.; WINOGRADOFF, N. N. Letter in *J. Sci. Instrum. Phys. Ind.*, **26**, 131–2 (*April*, 1949).—Discusses the importance of dielectric absorption in the insulation of ionization chambers and points out the low values of total absorption (~0·5%) in polystyrene and polyethylene. The mechanism of dielectric absorption, it is stated, is not yet fully understood. [See Abstr. 614 (1949)]. J. D. C.

537.562

5502. Photo-ionization and recombination of O^{++} ion. YAMANOUCHI, T. *Proc. Phys.-Math. Soc. Japan*, **23**, 757–63 (1941).—Probabilities of photo-ionization and recombination of positively charged ions of O were calculated by the method which is similar to that used in the investigation of the probabilities of radiative process of ionization and recombination of neutral O atoms [cf. Yamanouchi, *ibid.*, **22**, 60 (1940)] and the detachment and attachment of negative O atoms [*ibid.*, Yamanouchi, **20**, 564 (1940)]. The cross-section Q for photo-ionization by a light quantum of frequency ν is given by $Q = 8\pi^2\nu J/3c$ and J is approx. $J = J_0 - 0{\cdot}6$, where $J_0 = 0{\cdot}401$, $0{\cdot}413$ and $0{\cdot}423$ for ^3P, ^1D and ^1S respectively, and ε is the energy of electron.

S. C. A. P.

537.564

5503. Determination of the electron energy distribution in gases from Townsend's ionization coefficient. DEAS, H. D. AND EMELEUS, K. G. *Phil. Mag.*, **40**, 460–5 (*April*, 1949).—A method is given for testing

assumed forms for the energy distribution. It compares calculated and experimental values of the coeff. α/p. A previous conclusion, that the experimental values of α/p are compatible with a Maxwellian distribution for large values of X/p (X is the field strength), is reaffirmed. However, the discrimination between various types of distribution function becomes less certain as X/p increases.

L. S. G.

537.565

5504. A mobility analyser for gaseous ions. LANGEVIN, P. *J. Phys Radium*, **10**, 177–88 (*June*, 1949) *In French.*—A description is given of an apparatus to be used for the measurement of the mobilities of the ions produced in a gas by α- or X-ray irradiation. The apparatus consists, briefly, of 3 co-axial cylinders of which the middle one rotates between an inner and outer fixed cylinder. The inside cylinder is provided with an opening through which the ions diffuse, passing to a collector mounted flush with the outer cylinder, and traversing on their journey one of a series of openings in the moving cylinder. Due to the moving layer of gas, the diffusing ions are carried circumferentially round the cylinders and the collector is displaced, with respect to the opening in the fixed inner cylinder, round the circumference of the fixed outer cylinder. The ion current passing to the collector depends on the fraction of the primary ion current carried round to the collector by the rotating layer of gas. The paper discusses in detail the particle trajectories, the influence of Coriolis forces, diffusion and space charges. Geometrical factors are also treated in detail. Experimental work, it is stated, is in hand.

J. D. C.

537.568

5505. The free energies of hydration of gaseous ions. HUSH, N. S. *Aust. J. Sci. Res. A*, **1**, 480–93 (*Dec.*, 1948).—The distinction between free energy of ion/water-molecule interaction and the real free energy of hydration of a gaseous ion is pointed out, and the importance of Klein and Lange's measurement of the Volta-potential Hg/Hg^+ (soln.), which makes possible the direct calculation of real free energies of hydration of individual ions, thus providing a check on theoretical values, is emphasized. Utilizing this value, the equation $-\Delta F_h^\circ = -\Delta F_f^\circ + \Delta F_i^\circ + \Delta F_s^\circ - 103{\cdot}92\ z$ kcal. (where ΔF_s° is the free energy of formation of the gaseous monatomic element, ΔF_i° is the free energy of ionization, ΔF_f° is the free energy of formation of the aqueous ion, and ΔF_h° is the real free energy of hydration of the ion, of valency z, at 298·2°K) is derived from fundamental considerations. By means of this equation, the real free energies of hydration of 49 ions are calculated, using the most reliable data. It is proposed that these be provisionally accepted as standard values. Several subsidiary values for important ions are calculated indirectly. The difference between ΔF_h° and the free energy of ion/water-molecule interaction is discussed in relation to the surface structure of water: a value of $-0{\cdot}30$ V is derived for the χ-potential at the surface of pure water, and it is concluded that at the water/gas interface the positive poles of the surface layer are oriented towards the gas phase. The applicability of a modified Born equation in th calculation of free energies of hydration is discusse and a modified equation is proposed which yiel values of ΔF_h° for gaseous ions with noble g structure in excellent agreement with those calculate independently by the method described above.

537.58

5506. Thermionic emission. HERRING, C. AN NICHOLS, M. H. *Rev. Mod. Phys.*, **21**, 185–2 (*April*, 1949).—A review (divided into four se contained chapters) of thermionic emission primari from clean metals, but with indications of the mod fications which must be made in applying, in oth fields, the concepts discussed. Space-charge-limite emission is not treated. Chapter I deals wit Uniform Surfaces and Chapter II with Non-uniform Surfaces, confirming and elaborating Becker's e planation of "patch effects." Chapter III survey emission data since 1935, and Chapter IV the mode quantum-theoretical developments. The extensiv bibliography is mainly concerned with pape published after 1935.

T.

537.585 : 541.183

Evaporation heat of adsorbed atoms and ions. *Se Abstr.* 5761

COSMIC RAYS 537.591

537.59

5507. On some electronic techniques for the stud of cosmic rays. QUERCIA, I. F. AND RISPOLI, I *Nuovo Cim.*, **6**, 63–78 (*Jan.*, 1949) *In Italian.*—Ne circuits and techniques for use in coincidence an anti-coincidence sets of high resolution for cosmic-ra work are described.

U.

537.591

5508. On the positive excess of the hard compone in cosmic rays near sea level. BERNARDINI, G "*Cosmic Radiation*," *London, Butterworth's Scientif Publications Ltd.*; *New York, Interscience Publicatio Inc.*, (1949) 77–9.—The connection between positi excess in, and the generation process of, the meson component is examined. Evidence is advanced t show that the positive excess increases between se level and 5 000 m, above which altitude no furth increase is reported. It is suggested that in the high energy range the positive excess may decrease wi increasing meson energy.

537.591

5509. Temperature at the height of 100 mb and th intensity of mesons at sea level. DUPERIER, A "*Cosmic Radiation*," *London, Butterworth's Scientif Publications Ltd.*; *New York, Interscience Publicatio Inc.*, (1949) 73–5.—Records of triple coincidence have been made by using a 25 cm thick Pb absorbe between the counters. Comparison of meson intensi with the height of a number of pressure levels has le to considering the temp. of the air layer lying betwee 200 and 100 mb, with the result that this temp appears to be a factor closely controlling the meso intensity at ground level, this intensity increasin with increasing temp. The other meteorologic factors with which this coexists prove to be the ma

of air and the height of the 100 mb level, thus providing further evidence that the bulk of mesons originates in the immediate neighbourhood of this level. A.

537.591.1

5510. Investigation of primary cosmic radiation with nuclear photographic emulsions. BRADT, H. L. AND PETERS, B. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 5–14.—Several methods are discussed for determining the charge and energy of nuclei considerably heavier than H and He which have been found to be present in primary cosmic radiation. Application of these methods to tracks of the heavy primary cosmic-ray component in Ilford C2 emulsions shows the presence of nuclei from the neighbourhood of C in the periodic system up to the neighbourhood of Fe ($Z \simeq 20$ to 30). A nuclear explosion caused by the impact of what might have been a $\geqslant 3\times10^9$ eV C or O nucleus with a Ag nucleus of the emulsion is discussed. It is shown that both the magnitude of the flux and the distribution of ranges of the nuclei of the heavy primary cosmic-ray component may give valuable information regarding the origin of cosmic rays. A.

537.591.1

5511. Distribution of slow neutrons in free atmosphere up to 67 000 feet. LADENBURG, R. W. AND YUAN, L. C. L. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 35–7.—Two identical proportional counters filled with BF_3 of nearly pure B^{10} have been sent aloft up to an altitude of about 67 000 ft (20 000 m) by means of free balloons, one counter shielded with 0·030 in (0·076 cm) of Cd, the other enclosed in Sn of the same thickness. The difference between the counts of the two counters is supposed to be due only to slow neutrons. The counts and the pressure were radioed down by a telemetering system. Up to about 18 cm of Hg the counts increase exponentially with altitude according to a mean free path $\lambda \sim 160$ gm/cm² in agreement with previous measurements and with the increase of nuclear disruptions in the atmosphere. The counts of both counters as well as their difference show maxima at high altitudes; that for the difference appears at a pressure of about $\frac{1}{10}$ of an atmosphere as expected theoretically (Fluegge), but in contradistinction to measurements of Korff. Also, the absolute number of neutrons produced per g and sec in the atmosphere is computed and compared with the number of protons produced at the same altitudes. A.

537.591.1

5512. The meson theory of the penetrating component of cosmic radiation. KOBAYASHI, M. *Proc. Phys.-Math. Soc. Japan*, **23**, 891–914 (1941) *In English.*—An attempt was made to remove the difficulties of the meson theory to explain the penetrating component of cosmic radiation by discussing the validity of the quantum field theories. S. C. A. P.

537.591.1 : 539.18

5513. Cosmic ray mesons. PUPPI, G. *Nuovo Cim.*, **6**, 194–9 (*May*, 1949) *In Italian.*—Theoretical. It is assumed that π-mesons obey Bose statistics and are quanta of the nuclear field, while μ-mesons obey Fermi statistics and have nothing to do with nuclear forces. Experimental data on the disintegration of the π-meson, and on the capture and spontaneous decay of the μ-meson, can be fitted by assuming a universal interaction between Fermi–Dirac particles. L. P.

537.591.1 : 539.18

5514. Observation of nuclear disintegrations below ground. EVANS, J. AND GEORGE, E. P. Letter in *Nature, Lond.*, **164**, 20 (*July* 2, 1949).—Track-sensitive emulsions were coated and exposed for 60 days at a depth 60 m water equivalent, where the rate of star production is found to be $0{\cdot}01 \pm 0{\cdot}004$ stars/cm³/day. Since observed absorption of sea level star-producing radiation would leave a negligible intensity at this depth, it is proposed that these stars arise at the nuclear excitation from the scattering of μ-mesons by nucleons. The estimated cross-section ($0{\cdot}5\times10^{-28}$ cm²) is $\frac{1}{10}$ sea level cloud chamber estimates for this interaction, and the difference may arise from the hardening of the meson beam with depth. J. G. W.

537.591.1 : 539.18

5515. Low energy end of the differential meson spectrum. ROGOZINSKI, A. AND LESAGE, M. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 63–8.—Measurements were carried out, for the vertical direction, at the Observatoire de Meudon (148 m above sea level) under a roof of 2 mm Fe. A differential absorption method was used in order to obtain, by means of G–M counters, the differential meson spectrum. Results concern penetrating particles (mesons) of ranges comprised between 6·5 and 46·5 cm Pb. The spectrum was explored by recording simultaneously mesons traversing a certain thickness of Pb and stopping in an additional (differential) absorber of 4 cm Pb which determined the width of the spectrum band. The spectrum presents a pronounced min. at a thickness of about 25 cm Pb. If one assumes for each particle under investigation a mass 200 times that of the electron, the above ranges correspond, respectively, to momenta of 188, 740 and 450 MeV/c. The momentum band corresponding to the differential absorber varies from 59 to 55 MeV/c, from beginning to end of the explored spectrum. It was found that a min. thickness of 6 cm Pb, distributed in 3 equal layers, one above and the others between the counters, was necessary in order to obtain a reliable discrimination between electrons and mesons. The spectrum lies, in general, below similar spectra obtained by other authors working with different methods. A.

537.591.1 : 539.18

5516. Properties of the π- and μ-mesons of cosmic radiation. POWELL, C. F. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 83–98.—An account of the development of knowledge of the properties of π- and μ-mesons up to the end of 1948. The main features of the observations on mesons of cosmic radiation, with masses in the interval from 100 to 400 m_e, where m_e is the mass of the electron, can be accounted for in terms of two types

of particles, π and μ, which can be positively or negatively charged. The lighter μ-particles have a weak, and the heavier π-particles a relatively strong, interaction with nucleons. A.

537.591.1 : 539.18

The nature of cosmic ray mesons. *See Abstr.* 5676

537.591.1 : 539.18 : 530.145

5517. Cosmic ray mesons and meson theory. HEITLER, W. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 119–33.—The various theoretically possible types of interactions between fundamental particles are described with particular emphasis on the coupling between mesons and nucleons envisaged in Yukawa's theory of nuclear forces (N.F. coupling) and on those couplings that lead to spontaneous decay. Information about the coupling can be derived in particular from collision processes: capture of slow mesons, scattering of mesons by nucleons, meson production in nucleon/nucleon and photon/nucleon collisions. Present evidence shows that μ-mesons have a very weak coupling with nucleons, but that the coupling of π-mesons with nucleons shows all the features of N.F. coupling. In particular, present knowledge concerning meson production fits well with the theory based on N.F. coupling. Probably also τ-mesons (mass 700–1 000 m_e) are strongly coupled with nucleons. The nature of the penetrating particles in large air showers is discussed and it is shown that these particles cannot be accounted for as mesons produced by photons. They may not be identical with any of the known types of mesons. A.

537.591.15

5518. λ-mesons in air showers. COCCONI, G. AND GREISEN, K. Letter in *Nature, Lond.*, **163**, 810 (*May* 21, 1949).—The evidence of Janossy and McCusker [Abstr. 1980 (1949)] for λ-mesons in air showers, based on the effect of an added 1·7 cm Pb roof placed 50 cm over a shielded counter array, is criticized on the grounds that the initial shield (15 cm Pb) is insufficient completely to absorb the electron-photon cascade component of an extensive air shower. J. G. W.

537.591.15

5519. Production of penetrating particles in air showers. SALVINI, G. AND TAGLIAFERRI, G. *Nuovo Cim.*, **6**, 108–24 (*March* 12, 1949) *In Italian.*—Coincidences of various orders between 12 groups of counters were recorded at 2 100 m. Ionizing particles other than electrons were found to be produced locally and in groups: this local radiation is more important for showers of small density. L. P.

537.591.15

5520. Penetrating particles in extensive air showers. BUDINI, P. *Nuovo Cim.*, **6**, 163–75 (*May*, 1949) *In Italian.*—Theoretical. The penetrating particles are assumed to be mesons created by photons in a process having a cross-section $\propto Z$. This theory cannot account for all the particles observed, but the energy spectrum is in agreement with experiment. L. P.

537.591.15

5521. Penetrating particles in extensive air showers. CHOWDHURI, B. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 101–2.—The count of penetrating particles in association with extensive air showers is found to decrease when a thin Pb roof is placed 50 cm above the shielded counters. It is concluded that penetrating particles are locally produced by soft particles in the air shower and decay in flight within the distance of 50 cm. A

537.591.1

5522. Penetrating particles in air showers. JÁNOSSY, L. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications, Ltd.*; *New York, Interscience Publications, Inc.*, (1949) 103–9.—Investigations of various authors on extensive air showers are analysed. It is concluded that: (*a*) penetrating particles in air showers are produced mainly locally in the absorber covering shielded counters; (*b*) the penetrating particles are most probably produced by electrons and photons with a cross-section varying as Z^2 with atomic number; and (*c*) it is suggested that these particles might be of elementary charge and of a mass of 3–10 times that of the electron. Further it is suggested that such particles, if they exist, are likely to be highly unstable. This suggestion is in agreement with the postulate of λ-mesons made by the French school. A

537.591.15

5523. Observations on the ionizing particles in cosmic ray showers. ROCHESTER, G. D. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 111–15.—An account is given of the momentum spectrum of the particles in extensive air showers, the heavily ionizing particles in cosmic-ray showers, and the lightly ionizing penetrating particles in penetrating showers. Two photographs of penetrating showers which have been interpreted as evidence for unstable particles of mass $\sim 900\ m_e$, are also discussed. The integral spectrum of the particles in extensive air showers is found to be $N(>E) = k(E + E_C)^{-\gamma}$ with $\gamma = 1{\cdot}1 \pm 0{\cdot}3$ and $E_C = 1{\cdot}1 \times 10^8$ eV, a result consistent with the predictions of cascade theory. The heavily ionizing particles fall into 2 main groups which may be identified as the proton and meson groups. Although the 5 observed mesons are grouped about the 200 m_e curve, 4 could also be consistent with a mass of 300 m_e. The lightly ionizing penetrating particles in penetrating showers show 3 features: (1) a large positive excess, (2) momenta $\sim 10^9$ eV/c, and (3) several instances of anomalous scattering. It is concluded that this type of penetrating shower probably consists mainly of protons and a type of meson different from the 200 m_e meson. A

537.591.15

5524. Investigation of the density spectrum of wide atmospheric showers of high density. ZAKHAROVA, V. P. AND EIDUS, L. KH. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 4) 477–9 (1949) *In Russian.*—The exponent of the inverse power law of the density distribution of the wide atmospheric showers, $N(>\rho) = A\rho^{-K}$ was determined by numerous authors, from sea level up to 3 860 m altitude, as between 1·42 and 1·5, for the range from 3 to 300 particles/m². The authors

found $K = 1{\cdot}76 \pm 0{\cdot}12$ for the dense showers ($\leqslant 5\,000$ particles/m²). The value was obtained from triple and six-fold coincidences in a horizontal circular arrangement of self-quenching argon–ethylene-filled counters at 3 860 m altitude (Pamir). B. F. K.

537.591.15

5525. Narrow atmospheric showers of cosmic ray particles. Neslin, M. V., Rosenthal, I. L. and Slavatinski, S. A. *Dokl. Akad. Nauk, SSSR*, **55** (*No.* 5) 641–4 (1949) *In Russian.*—Results of triple and quadruple coincidence observations at 3 860 m altitude (Pamir) in 1948 may be interpreted thus: The narrow showers contain a large number of soft particles absorbed by 1 cm Pb and also in the walls of the boxes containing the counters; dense narrow meson formations were not observed; number of particles penetrating 20 cm Pb is small, though no quantitative estimation can be attempted owing to the unknown angular distribution of the narrow showers. The presence and essential influence of photons were ascertained, and the narrow showers certainly comprise electrons, photons and penetrating particles. From Wilson chamber pictures it is known that these constituents form the "special" showers where the soft component has marked directional character. It is very likely that narrow and special showers are due to the same processes. B. F. K.

537.591.15

5526. "Special" showers of cosmic radiation. Azimov, S., Bürger, N. and Gorbunov, A. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 5) 625–8 (1949) *In Russian.*—The "special" showers, discovered during the Pamir expedition 1945 and further observed during the 1946–47 expeditions, are produced in 13 cm Pb screens and characterized by the simultaneous occurrence of heavy, strongly ionized and penetrating particles and electrons. Further investigations have shown that they cannot be produced by either mesons of the hard component, nor by photons or electrons. One is led to imagine an "explosive" origin due to interaction of high-energy particles in the state of nuclear interaction, with nuclei of matter. The authors report on investigations carried out in 1948 with a Wilson chamber and 39-cell hodoscope, at an altitude of 3 860 m. As controlling impulses quadruple coincidences of the counters were used which, if they were due to lateral air showers, would be eliminated with certainty by the hodoscope. It could be established that the wide air showers contain particles strongly interreacting with nuclei and capable of producing "special" showers. Some example of "special" showers are given in pictures and the analysis of their constituents is carried through. (Bibliography of 12 entries.) B. F. K.

537.591.15

5527. Structure of cosmic-ray air showers. Prescott, J. R. and Mohr, C. B. O. Letter in *Nature, Lond.*, **164**, 21–2 (*July* 2, 1949).—Coincidences were studied between thin-walled ionization chambers containing N_2 at 39 atmospheres at various separations under 0, 0·5 and 1·0 cm Pb. The strong shield-dependence of the rate of a single chamber, which is $\sim 20\times$ the coincidence rate for separations >50 cm is considered to be attributable to narrow showers. J. G. W.

537.591.15

5528. Investigation of the structure of the wide atmospheric showers of cosmic rays. Artyukhov, G. Y. and Eidus, L. Kh. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 5) 629–31 (1949) *In Russian.*—Earlier observations had given reason to surmise the existence of narrow dense beams of relativistic particles in the general structure of the wide atmospheric showers, whilst a confirmation of this was impossible with the set-ups used. The authors used the multiple coincidence method for this purpose, more particularly, the sextuple coincidences of the discharges of rapid-acting, small area counters, arranged in star-form, which correspond to the passage of a shower of high density (>850 particles/m²). Two star arrangements of counters, spaced to 1·8 m distance, and one large-area counter (330 cm²) at a distance of 3 m from either star were used. The investigation of the form of the spectrum in the range of very high densities actually yielded that an intensification took place in this range. The crucial experiment, whether the "special" showers could be proved to be due to narrow beams of high density, had a negative result. This still leaves the possibility of beams existing, the dimensions of which are small compared with those of the instruments used, a rather improbable assumption. B. F. K.

537.591.3

5529. On nuclear evaporation and absorption of the nucleonic component [of cosmic rays]. Bernardini, G., Cortini, G. and Manfredini, A. "*Cosmic Radiation,*" *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 21–7.—The absorption of star-producing radiation was measured in air (up to 22 km altitude) and in other materials. The resulting cross-section may be expressed by $\sigma = kA^{2/3} \times 10^{-26}$ cm² with $k \sim 3$. But from the discussion it appears that the above cross-section is to be considered essentially related to the absorption of the primary component, the stars being produced mainly by secondary nucleons which are in turn produced by the primary component itself. The average ratio between the numbers of primary and secondary nucleons is about 1/10. A.

537.591.5

5530. Latitude effect and pressure-level of meson formation. Duperier, A. Letter in *Nature, Lond.*, **163**, 369–70 (*March* 5, 1949).—In addition to the latitude effect for mesons at sea level discussed by Kupferberg [Abstr. 2153 (1948)] and Rathgeber [Abstr. 3824 (1948)] arising from variations of height of the assumed (constant) pressure level of meson formation in the atmosphere, an effect of comparable magnitude will arise from temp. (and hence density) variation with latitude at this pressure level. These effects greatly reduce the residual magnetic contribution to the observed latitude effect. It is pointed out that this conclusion is invalid if an appreciable variation of the effective pressure level of meson formation with latitude exists. J. G. W.

537.591.5

5531. Recordings of cosmic radiation. MALMFORS, K. G. *Tellus*, **1**, 55–61 (*May*, 1949) *In English.*—The main purpose of the recordings reported here has been to study the diurnal variations and especially to investigate how the amplitude and the phase of the variations depend on the direction of incidence. Since statistical fluctuations will dominate over the significant ones unless a sufficiently large number of coincidences is counted, it has been necessary to use an apparatus with a high counting speed. Cosmic rays have been recorded continuously in Stockholm (magn. lat. 58°) since Oct. 1947 by means of large counters in coincidence circuit. Recordings have been made in 3 different directions simultaneously, and the total number of particles counted amounts to 10^9. The material has been analysed with respect to diurnal variation. This analysis definitely proves that the variation is not the same in different directions. A term called cosmic-ray activity has been introduced for the purpose of classifying the records according to the magnitude of the variation for each day. An analysis shows that large activity is very often observed during consecutive days. A.

537.591.5

5532. Zenithal effects of meson radiation. ROGOZINSKI, A. AND VOISIN, A. G. "*Cosmic Radiation,*" *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 69–72.—Investigations were performed by a method similar to that described in Abstr. 5515. Measurements were carried out on the integral spectrum of the penetrating component (mesons), filtered by 6·5, 14·5 and 22·5 cm Pb and for zenith angles θ of 0°, 30°, 60° and 73° E. It was found that the zenith dependence of the frequency $I(\theta)$ of the mesons is given by the law $I(\theta) = 1(0) \cos^{2\cdot20 \pm 0\cdot06} \theta$. The same law applies within the limits of experimental error to the meson radiation filtered by the 3 thicknesses of Pb. Zenithal distribution of several bands of low energy mesons selected by a differential absorber of 8 cm Pb were also investigated. It seems that this distribution does not follow a simple cosine power law. In addition several points of the differential meson spectrum were determined for the various zenith angles. These spectra are in agreement within the limits of statistical error with the differential spectrum obtained by Rogozinski and Lesage for the vertical direction. Control measurements have shown that only about 0·1% of the mesons investigated actually consist of very narrow showers. A.

537.591.5 : 551.5

5533. Cosmic rays and high altitude meteorology in tropical regions. SEKIDO, Y. *J. Phys.-Math. Soc. Japan*, **16**, 78 (1942).—From the investigation of the pressure effect of cosmic rays it was inferred that the upper temp. rises with the increase of atmospheric pressure in middle latitude regions and decreases in the low latitudes. The former part of the inference agrees with the well-known fact, and the latter part has been ascertained by Arakawa (see *J. Met. Japan*, **19**, 392) from the investigation of sonde observations at Batavia, which fact indicates that cosmic-ray intensity has a close relation to meteorology. S. C. A. P.

537.591.5 : 551.5

5534. Cosmic rays and seasonal precipitation. SEKIDO, Y. *J. Phys.-Math. Soc. Japan*, **16**, 78 (1942).—A remarkable parallelism has been shown between the annual variation of the pressure effect coeff. of cosmic rays on the sea near Manila and monthly precipitation at Manila (1865–1910). S. C. A. P.

537.591.8

5535. Angular distribution, frequency and absorption of slow single cosmic ray protons. LATTIMORE, S. *Phil. Mag.*, **40**, 394–403 (*April*, 1949).—In certain photographic plates exposed to cosmic rays, tracks due to protons other than those forming "stars," are observed. These are the protons studied. The angular distribution is calculated, both for a horizontal plate and a vertical plate. Experimental results were obtained using Ilford 100 μ C.2 emulsion on glass 1 mm thick at 3 600 metres. It is concluded that the protons cannot all be produced by stars similar to those observed in the emulsion. The mode of production is obscure. H knock-ons can be excluded and penetrating showers can only explain about 1%. L. S. G.

537.591.8

5536. Heavy splinters in cosmic ray stars. BONETTI, A. AND DILWORTH, C. *Phil. Mag.*, **40**, 585–7 (*May*, 1949).—In an exposure at Pic du Midi (2 850 m), 300 μ Ilford C_2 plates were exposed in sandwich, so that an effective thickness of 600 μ was presented. The existence of highly charged particles was established. A photograph of one event is shown. It is a star of 20 branches, of which 4 are heavy particles of long range. These particles are discussed, and their charges are estimated. An estimate of the total energy of the star is also made. L. S. G.

537.591.8

5537. Origin of cosmic ray stars. HARDING, J. B. *Phil. Mag.*, **40**, 530–45 (*May*, 1949).—The stars investigated were produced in Ilford "Nuclear Research" emulsion exposed vertically at 3 650 m. Measurements of track lengths of all particles ejected from the stars show that few have ranges between 10 μ and 20 μ. The "recoil" tracks, having ranges $< 10\ \mu$, are probably caused by residual nuclei, left when the highly excited nuclei have cooled down by particle emission. The length and angular distribution of these recoil tracks are investigated, and these data provide evidence about the radiation causing nuclear disintegration. The range of recoils is compared with the theoretical range. It is concluded, after thorough discussion, that the majority of cosmic-ray stars observed in emulsions are due to either fast neutrons (not captured), fast mesons which give up all their rest energy, or possibly "heavy mesons" which are captured in the upper part of the nuclei. L. S. G.

537.591.8

5538. The production of cosmic ray stars. THOMSON, G. *Phil. Mag.*, **40**, 589–600 (*June*, 1949).—The number of stars produced in a given kind of photographic plate decays exponentially with the amount of the atmosphere above the plate. The size of a star is independent of height. These facts are shown to be consistent with the view that one primary particle makes several effective collisions in the atmosphere. The mechanism of production of stars

s examined. The effects are most likely due either to nucleons passing down through the atmosphere and alternating in state between protons and neutrons as a result of nuclear collisions or to neutrons. In either case each primary particle must make several tracks or stars. The production of tracks by the primaries is direct; that of the stars may be direct or through a non-ionizing link. The mathematical analysis of the energy loss of a primary particle is based on the assumption that the energy is lost in a number of steps, so large that the loss may be regarded as continuous. L. S. G.

537.591.8 : 539.17

On the cosmic-ray stars. *See Abstr.* 5644

537.591.8 : 539.172

5539. Nuclear collisions of heavy cosmic-ray primaries. BRADT, H. L. AND PETERS, B. Letter in *Phys. Rev.*, **75**, 1779–80 (*June* 1, 1949).—Exposure of photographic emulsions at high altitudes (~ 90 000 ft) has led to a classification of the collisions of heavy nuclei entering the atmosphere. These may (1) proceed with little deflection and no loss of charge with the emission of a few nucleons by the target nucleus; (2) be completely destroyed in a nuclear explosion; (3) lose an appreciable part in a collision from which the remainder of the nucleus goes on in a more or less dissociated state. The last mechanism leads to a very narrow penetrating shower (example given with angular separations ~ 0·1°). J. G. W.

537.591.8 : 539.172

5540. Cross-section for nuclear disintegration produced by cosmic rays. HARDING, J. B. Letter in *Nature, Lond.*, **163**, 440–1 (*March* 19, 1949).—A study of the cross-section for star production has been carried out in "gelatin sandwich" nuclear plates. Stars formed in the emulsion proper can arise from Ag, Br and light nuclei while those formed in the gelatin layers must be due to the disintegration of C, O or N. Stars having their origin in the gelatin can be recognized as their centres are not visible. The ratio of gelatin to emulsion stars has been found to be $5{\cdot}8 \pm 0{\cdot}7\%$. A computation of the ratio of the geometrical cross-section yields a value of only $4{\cdot}53\%$. From an analysis of gelatin stars it seems probable that about ½ the heavily ionized tracks are formed by particles having a charge > that of an α particle. R. H. H.

537.591.8 : 539.172

5541. The angular distribution of tracks in disintegration stars produced by cosmic rays. LOVERA, G. *Nuovo Cim.*, **6**, 233–4 (*May*, 1949) *In Italian.*—A statistical study of small stars ($n = 3, 4, 5$) produced in Ilford plates by radioactive contaminations shows that the distribution of the tracks is isotropic. L. P.

537.591.8 : 539.172

5542. Energy and angular distributions of protons and alpha particles emitted from stars. The cross section for star production. PERKINS, D. H. "*Cosmic Radiation,*" *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 17–20.—Analysis of cosmic-ray stars indicates that the distribution of protons released in the disintegration of heavy nuclei can be explained by an evaporation process at all excitation energies up to the nuclear binding energy. At high excitation, different process, probably that of fission or localized boiling, is responsible for the ejection of α particles. Observations on stars produced in layers of emulsion and pure gelatin indicate a cross-section for disintegration $\propto$ the geometrical area of the nucleus. A.

537.591.8 : 539.172

5543. Nuclear disintegrations in photographic plates exposed to cosmic rays under absorbers. GEORGE, E. P. AND JASON, A. C. "*Cosmic Radiation,*" *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 31–4.—The frequency of cosmic-ray stars has been recorded at the Jungfraujoch (3 457 m altitude) in Ilford plates exposed under various absorbers of C and Pb. Their frequency was also recorded in a control batch of plates kept at sea level. When allowance is made for the small contributions arising from the capture of σ-mesons, the number of stars is found to decrease exponentially with the absorber thickness. The absorption measurements are consistent with the assumption that the range of radiation responsible for these stars in a material of atomic weight A is $\propto A^{\frac{2}{3}}$. The size distribution of the stars was found to be substantially the same under all absorbers, and in the plates exposed at sea level. A.

537.591.8 : 539.172

5544. Observation of energetic deuterons ejected from cosmic stars. HOANG T.-F., JAUNEAU, L. AND MORELLET, D. "*Cosmic Radiation,*" *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 185–6.—Ilford C2 boron loaded plates were exposed for detection of deuterons emitted by complex nuclear disintegrations. The two phenomena observed are discussed. A.

537.591.8 : 539.172

5545. Some experimental results on the production of stars and single tracks. MORAND, M. AND CÜER, P. "*Cosmic Radiation,*" *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 29–30.—Nuclear emulsions were exposed at sea level, at 1 000 and 3 500 m, and under 35 cm of Pb at 3 500 m. The stars and single tracks were measured. Because of the rare occurrence of events at low altitudes, a wide variety of exposures was used supplemented by a detailed study of track fading. Mass coeffs. of absorption of the radiation-producing stars and single tracks in air and Pb are $\simeq 100 \pm 20$ and $\simeq 300 \pm 30$ gm/cm² while the principles of conservation of energy and momentum give the mass of the incident particle as approx. one proton mass when applied to known disintegrations. Distribution of single tracks is mainly vertical: their presence cannot be accounted for by stars alone. A.

537.591.8 : 539.172

5546. Mechanism of π-meson disintegrations. PERKINS, D. H. *Phil. Mag.*, **40**, 601–13 (*June*, 1949).—Observations were made on 120 disintegration stars produced by nuclear capture of slow negative mesons. These confirm previous hypotheses [Abstr. 2200 (1948)] accounting for the conversion of the meson rest-energy into nuclear excitation energy. Evidence

from grain counts together with previous measurements of the mass of the star-producing mesons [Abstr. 2207 (1948)] indicates that these mesons can be identified with the negative π-mesons of mass 285 produced in the Berkeley cyclotron [Abstr. 3453 (1948)]. L. S. G.

537.591.8 : 539.172

5547. Some properties of nuclear explosions in cosmic rays. Lovati, A., Mura, A., Salvini, G. and Tagliaferri, G. *Nuovo Cim.*, **6**, 207–16 (*May*, 1949) *In Italian.*—Nuclear explosions were studied at 3 500 m by means of a counter-controlled Wilson chamber. The diffusion in Pb of the penetrating particles emitted in the explosions indicates that these particles are either protons or π-mesons. L. P.

537.591.8 : 539.172

5548. Nuclear interactions of the particles produced in cosmic ray bursts. Lovati, A., Mura, A., Salvini, G. and Tagliaferri, G. *Nature, Lond.*, **163**, 1004–6 (*June* 25, 1949).—Experiments at 3 500 m altitude in which penetrating cosmic-ray showers were examined in a cloud chamber containing three 1·2 cm Pb plates, draw particular attention to successive penetrating events. It is concluded that the range of production of secondary events is not greatly different from that of primaries. J. G. W.

537.591.8 : 539.172

5549. Heavy nuclear splinters. Hodgson, P. E. and Perkins, D. H. Letter in *Nature, Lond.*, **163**, 439–40 (*March* 19, 1949).—From a total of 6 000 stars observed in nuclear emulsions two examples have been found in which highly charged nuclear splinters are ejected from strongly excited nuclei. These two stars were obtained in gelatin sandwiched emulsions exposed on the Jungfraujoch. In one case the charge of one splinter is estimated from the "thin down length" of the track to be $11 \pm 1\,e$. The energy of the particle producing this track (195 microns long) is estimated as 325 ± 50 MeV and its momentum 3 500–400 MeV/c. The charge of a second heavy fragment in the same event is estimated to be $\geqslant 6\,e$. From the additional number of protons and α emitted by the parent nucleus the charge of the latter must have been $\geqslant 35 \pm 3\,e$. It is believed that this event represents the complete disintegration of a Br nucleus. R. H. H.

537.591.8 : 539.172

5550. Transition effect in lead of star-producing radiation. Cortini, G. and Manfredini, A. Letter in *Nature, Lond.*, **163**, 991–2 (*June* 25, 1949).—The transition maximum at about 20 g/cm² for production of cosmic-ray stars under Pb was examined at 3 500 m altitude, and is shown to arise almost entirely from an increase of three-pronged stars (the smallest distinguished). The effect is attributed to the replacement of fast incident nucleons by their slower nucleon secondaries as the immediate star-producing agency. J. G. W.

537.591.8 : 539.18

5551. Concerning new elementary particles in cosmic rays. Alichanian, A. I. and Alichanow, A. I.; Powell, C. F. Letter in *Nature, Lond.*, **163**, 761 (*May* 14, 1949).—Summarizes the results of papers published in Russia since January 1947, which claim to give evidence for new elementary particles based on simultaneous measurements of magnetic curvature and range. The latest results are taken to indicate the existence of mesons with mass values: 110, 140, 200, 250, 300, 350, 450, 550, 680, 850, 1 000, 1 300, 2 500, 3 800, 8 000, 25 000 electron masses, called "varytrons." Recent observations at Bristol and Manchester are alleged to confirm this earlier work and attention is drawn to its neglect by Powell and Blackett. In reply, Powell remarks that the neglect of the work on "varytrons" is attributed in part to the present hindrances to intercourse between east and west scientists. He concludes that mesons heavier than π and μ mesons must be very rare. E. P. G.

537.591.8 : 539.18

5552. Nuclear capture of μ-mesons. Perkins, D. H. Letter in *Nature, Lond.*, **163**, 682–3 (*April* 30, 1949).—An examination is made of the ends of tracks of slow mesons observed in photographic emulsions. From the absence of tracks that could be attributed to recoil nuclei it is concluded that slow negative μ-mesons are captured by protons producing a neutron and a light neutral particle. E. P. G.

537.591.8 : 539.18

5553. Production of meson showers. Heisenberg, W. Letter in *Nature, Lond.*, **164**, 65–6 (*July* 9, 1949).—The consequences of the multiple production of mesons in a single nucleon–nucleon collision are re-examined. It is assumed that a large part of the kinetic energy of the nucleons in the c.g. rest system enters the meson field and is dissipated by an isotropic emission of mesons with an energy spectrum of index -1. Transformation to a system in which one nucleon is initially at rest leads to the multiplicity and angular distribution of meson-producing events. Consideration of the π–μ transition then leads to the μ-meson spectrum and positive excess. Attention is drawn to the possibility of disturbing effects when the target nucleon is in a nucleus. J. G. W.

537.743 : 621.317.733

5554. The Maxwell bridge at low frequencies. Brown, V. A. and Ramsay, B. P. *Rev. Sci. Instrum.*, **20**, 236–8 (*April*, 1949).—The Maxwell bridge has been found useful for measuring inductance L and a.c. resistance R_{ac} at periods from 0·01 sec to 200 sec. In some applications, the inductors had solid ferromagnetic cores and inductances of several hundred henries. The effect upon the bridge circuit of induced currents in the ferromagnetic material is expressed as a first approximation in terms of the equivalent mutual inductance M. The resulting equations expressing the frequency dependence of L and R_{ac} are in qualitative agreement with experiment. Because of harmonic frequencies generated by magnetic hysteresis, the bridge cannot be completely balanced when measuring L and R_{ac} of ferromagnetic-cored inductors. Analysis of the precision of measurement indicates that the effect of the residual voltage at best balance is a reduction in bridge sensitivity. Factors determining the choice of bridge resistors and of balance indicator are discussed, and typical graphs of L and R_{ac} as functions of frequency are presented. A.

537.743 : 621.317.733

5555. A wide-range capacitance conductance bridge. Cole, R. H. and Gross, P. M., Jr. *Rev. Sci. Instrum.*, **20**, 252–9 (*April*, 1949).—The bridge described has been developed for accurate measurement by direct balance of capacitance and conductance in the range 50 c/s to 5 Mc/s, and over most of this range is essentially direct-reading in the two admittance components with negligible unbalance from lead effects or guard circuits of the unknown. These properties are realized by using two circuits. The first employs inductively coupled ratio arms to minimize residual impedance effects and unbalance by guard circuits, the second, a conductance shifter star network with good h.f. properties and an essentially linear conductance reading. Design considerations and limitations of these circuits are discussed, as are suitable test cells and auxiliary equipment. A.

MAGNETISM 538

538.082.1 : 621.317.44

5556. An electronic fluxmeter. Dicke, R. H. *Rev. Sci. Instrum.*, **19**, 533–4 (*Aug.*, 1948).—The instrument described has a performance similar to the Grassot meter. The e.m.f. developed across a search coil tends to produce a galvanometer deflection. By means of a photo-electric d.c. amplifier system a signal is fed back into the galvanometer circuit so as to oppose (and largely prevent) the original deflection. The system is thus self-balancing, is practically independent of the auxiliary voltage and remains constant over a wide range of the voltage to be measured above a minimum value; it varies, however, with the cathode heating voltage. For the triode considered, the error is fully eliminated if the measured voltage is > 50 V. The auxiliary voltage should be of the same order as that to be measured. A. K. (R)

538.082.74 : 621.317.42

5557. On the conditions for improving the measurement of magnetic induction with the help of the bismuth spiral. Petrescu, V. and Luca, E. *Bull. Inst. Polytech. Jassy*, **3**, 808–13 (*July–Dec.*, 1948) *In French.*—Possible sources of error include heating of the spiral by the bridge current and by proximity of heated parts of machines, with consequent dilation of the spiral. Errors can be minimized by compensation methods using two identical spirals, one being enclosed and maintained at the temp. found in the test gap. Sensitivity can be increased by means of a series of variable shunts connected across the balancing resistances. With proper choice of the shunt resistances, values of $\partial R/R$ may be read directly. A. W.

538.082.742 : 621.317.42

5558. A magnetic field strength meter using the proton magnetic moment. Hopkins, N. J. *Rev. Sci. Instrum.*, **20**, 401–2 (*June*, 1949).—A simple, portable instrument is described which employs the nuclear absorption method and the known value of the proton magnetic moment to determine magnetic field strength. No known fields and no geometrical calculations are required for calibration. The range covered by the present instrument is approximately 3 000 to 19 000 gauss. No upper limit is inherent in the method. Homogeneity is required over a small cylindrical volume. Absolute accuracy of better than $\pm 0{\cdot}2\%$ is obtainable, depending only on precise measurement of frequency. Higher accuracy is possible in comparing fields and in measuring field changes. A.

538.082.742

5559. A new high sensitivity remanent magnetometer. Johnson, E. A., Murphy, T. and Michelsen, P. F. *Rev. Sci. Instrum.*, **20**, 429–34 (*June*, 1949).—The remanent magnetometer, sturdily constructed for use in a mobile field laboratory, is capable of measuring magnetic moments of rocks as small as 2×10^{-8} c.g.s. unit per cm³. A sample of rock of 25 to 50 cm³ volume is rotated over a pick-up coil at 10 c/s, and the induced alternating voltage, after amplification, is measured in both intensity and phase, and the direction and intensity of magnetization determined. The apparatus is calibrated with a needle-magnet of known magnetic moment. A.

538.114

5560. Interchange interaction and collective electron ferromagnetism. Wohlfarth, E. P. *Phil. Mag.*, **40**, 703–17 (*July*, 1949).—The interaction energy terms are discussed and calculated for free electrons. If the energy for anti-parallel spins is taken into account the total energy may vary as the square of the magnetization [Abstr. 2167 (1938)]. The 3 chief methods of approximation in calculations relating to actual atoms are outlined; and a possible explanation is given of the discrepancy between the calculated and observed magnetization/temperature curve of Ni. It is suggested that the collective electron treatment provides a much better approach to problems of ferromagnetism than the Heitler–London–Heisenberg method. L. S. G.

538.114 : 538.652

5561. The Weiss–Heisenberg theory of ferromagnetism and a new rule concerning magnetostriction and magnetoresistance. Snoek, J. L. Letter in *Nature, Lond.*, **163**, 837–8 (*May* 28, 1949).—On the Weiss–Heisenberg model some ferromagnetic properties should be associated with alloys with an integral mean number of Bohr magnetons. An examination of the properties of alloys in which this condition is fulfilled indicates that it is associated with zero magnetostriction and maximum magnetoresistance. A. E. De B.

538.214 : 539.133

5562. Ferromagnetic interaction in manganese alloys. Castelliz, L. and Halla, F. *Acta Phys. Austriaca*, **2** (*Nos* 3–4) 348–55 (1949) *In German.*—Sets out to determine the spin orientation of Ti, V, Cr, Mn, Co, Ni, Cu, dissolved in Mn as a solvent. As the interaction in pure Mn is antiferromagnetic, a ferromagnetic Mn alloy, viz. the ε-phase of a Mn–Sb alloy, was chosen. In this alloy the Mn contributes the magnetic moment. The results of susceptibility measurements agree well with a rule derived by v. Auwers [Abstr. 5105 (1937)] from measurements on alloys of the same metals with Fe, Co, Ni, as solvents, according to which atoms are built into the

solvent lattice with parallel-spin orientation until a maximum magnetic moment is reached. When this is exceeded, further atoms enter the lattice with antiparallel-spin orientation. The maximum moment occurs when the sum of the outer electron numbers of solvent and solute is 17. The method of measurement was based on a fluxmeter method due to Schultz [*Diss. Haarlem* (1940)]. A special galvanometer was used, with two coils supplied with currents of opposite direction. The specimen was inserted into one of the coils in the form of a small sphere, and the out-of-balance mechanical couple compensated by adjusting the current in one of the coils. H. MO.

538.221

5563. The variation with temperature of the permeability and after-effect of ferromagnetic materials. FAHLENBRACH, H. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 7–8) 355–69 (1948) *In German.*—Describes parallel measurements of permeability and its time-decrease in the temp. range −200°c to the Curie point on commercial pure irons and Fe–Si, Fe–Ni and Fe–Cr–Al alloys at values of H up to that for maximum μ. In agreement with Snoek's theory of magnetic after-effect [see Abstr. 4237 (1938), 1818 (1939)] abnormally low permeability and the occurrence of time-decrease were observed, invariably in association, in various temp. ranges. The normal large increase of μ with temp. up to just below the C.P. was found, except in two materials having large random internal stresses, and is attributed to increasingly random distribution of the directions of domain magnetizations, produced by increased temp. A similar effect is produced by a superposed a.c. field in conditions of "ideal" magnetization. C. E. W.

538.221

5564. Effect of external tension upon the initial permeability of iron single crystals. KAYA, S., TAOKA, T. AND IKI, T. *Proc. Phys.-Math. Soc. Japan*, **24**, 865–74 (1942) *In German.*—The relations between tension and initial permeability of Fe single crystals were observed. The change of initial permeability caused by tension depends upon the method of demagnetization. In tetragonal crystals it increases by pressure; while in diagonal and trigonal crystals the change is small. S. C. A. P.

538.221

5565. Effect of external tension upon magnetization and magnetostriction of iron single crystals. TAKAKI, H. *Proc. Phys.-Math. Soc. Japan*, **24**, 875–98 (1942) *In German.*—In connection with the problem of magnetic properties of Fe single crystals and external tension [see preceding Abstr.], the change of the form of hysteresis loop, initial magnetization of Fe single crystals by external tension were measured. S. C. A. P.

538.221 : 537.311.33

5566. Ferromagnetism of semi-conductors. HIRONE, T. AND MIYAHARA, S. *Proc. Phys.-Math. Soc. Japan*, **24**, 560–8 (1942) *In English.*—The ferromagnetism of semi-conductors having various electronic structures is discussed on the basis of the Wilson model of semi-conductors as well as the Bloch theory of ferromagnetism. It was found that the conditions for the appearance of ferromagnetism by various semi-conductors are remarkably affected by their types of electronic structures. S. C. A. P.

538.22

5567. Microwave resonance absorption in a para magnetic organic compound. HOLDEN, A. N., KITTEL C., MERRITT, F. R. AND YAGER, W. A. Letter in *Phys. Rev.*, **75**, 1614 (*May* 15, 1949).—A paramagneti resonance curve 42 oersteds in ½-width at 8 60 oersteds is observed at 24 446 Mc/s in a compound existing as free radicals in the solid state. The g value is close to 2, the free spin value. D. H. W.

538.22

5568. Thermodynamic theory of paramagnetic ab sorption in perpendicular fields. SHAPOSHNIKOV, I. G. *J. Exp. Theor. Phys., USSR*, **19**, 225–30 (*March* 1949) *In Russian.*—It was established that the para magnetic absorption in the case of perpendicular fields is only due to spin-spin relaxation. An expression was found for the energy absorbed by an ideal paramagnetic, the magnetism of which is of a pure spin character, for a time unit based on the period of the field. It appeared that this quantity, apart from the frequency of the field and the amplitude of its alternating component, also depends on the constant field component, partly explicitly, and partly through the spin-spin relaxation time. The form of this dependence on the constant field component and on the temperature, however, could not yet be determined. The evaluation of the experimental data on the position of the maximum of the absorption curve showed that the spin-spin relaxation time increases with increasing field. The law of this growth for strong and weak fields (according to a certain definition) is given. It could also be shown that the character of the dependence of the relaxation time on the field is adequately described by the formula, as the agreement between measured values and those calculated on the formula is fully satisfactory. B. F. K.

538.222

5569. Paramagnetic resonance absorption in some crystal powders. KOSYREV, B. M. AND SALIKHOV, S. G. *J. Exp. Theor. Phys., USSR*, **19**, 185–92 (*March*, 1949) *In Russian.*—The paramagnetic absorption in a series of paramagnetic salts is investigated, among which $Cu(NO_3)_2 \cdot 6H_2O$ and $Cu(NH_3)_4SO_4 \cdot H_2O$ were studied for the first time as to their magnetic spin resonance. The measurements were carried out at frequencies of $2{\cdot}07\times10^8$ and $0{\cdot}688\times10^8$ c/s and at room temperature. It was found (1) that the position of the maximum on the curves of the coefficient of absorption χ'' *v.* the constant magnetic field strength satisfies the condition $h\nu = g\mu_0 H$; (2) that the ½-width of these curves is practically independent of the frequency; (3) that neither the position of the maximum nor the ½-width, as had been shown on the example $CrCl_3$, depend on the quantity of substance absorbed and on the sensitivity of the operating conditions of the high-frequency generator; (4) that the product of the maximum value of the coefficient χ'' and the ½-width $\propto$ the static permeability of the substance absorbing the energy of the h.f. magnetic field. B. F. K.

538.222 : 536.48

5570. Magnetism and the third law of thermodynamics. Magnetic properties and heat capacity of $CoSO_4 \cdot 7H_2O$ from 0·1 to 15°K. FRITZ, J. J. AND GIAUQUE, W. F. *J. Amer. Chem. Soc.*, **71**, 2168–75

June, 1949).—The magnetic susceptibility and heat capacity of $CoSO_4 . 7H_2O$, together with associated thermodynamic data, have been measured between about 0·2 and 15°K. The thermodynamic temp. has been estimated for measurements in zero field to ·25°K. The magnetic data and heat capacities agree with the assumption of a set of low-lying levels of the ground state multiplet with an over-all spacing of the order of a few tenths of a wave number. The data on intensity of magnetization can be explained at the lower temp. by the assumption of 4 magnetic levels of very small separation, such as could arise from the electron spins alone, with the orbital contribution "quenched." The residual magnetism after demagnetization to temps. as low as 0·16°K, from magnetic fields sufficient to produce about 25% saturation, is at most 1 part in 40 000 of the "spinonly" saturation value. The energy absorbed due to magnetic hysteresis is no more than 1 part in 8 000 at about 0·2°K for a.c. fields up to 14 oersteds, 60 c/s, and 29 oersteds, 550 c/s. The entropy of $CoSO_4 . 7H_2O$ at 1°K is 2·73, and at 15°K is ·16 cal. deg.$^{-1}$ mole.$^{-1}$. A.

538.222 : 539.11

5571. Hyperfine structure in the solid state. Penrose, R. P., Gorter, C. J., Abragam, A. and Pryce, M. H. L. Letters in *Nature, Lond.*, **163**, 992–3 (*June* 25, 1949).—Hyperfine structure to the paramagnetic resonance is observed in a dilute Cu salt due to the decoupling of the electronic and nuclear spins. Discrepancies between theory and experiment are pointed out. D. H. W.

538.24

5572. Magneto-thermal effects in ferromagnetics. Stoner, E. C. and Rhodes, P. *Phil. Mag.*, **40**, 481–522 (*May*, 1949).—The thermodynamics of magnetization is discussed, and elementary magnetization processes are considered. These include change of intrinsic magnetization, rotation of the domain magnetization vector in the anisotropic crystalline field, in its pure form and as modified by strains, and the reversible and irreversible movement of domain boundaries. The thermal changes associated with these processes are considered and the atomic interpretation of the effects is discussed. Detailed analyses are given for Fe, Ni and Co. It is shown that the magneto-caloric results, when supplemented by other data, can provide valuable information about the elementary processes over the whole range of a magnetization curve. L. S. G.

538.24

5573. The phenomenon of delayed magnetization discontinuities. Telesnin, R. V. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 5) 887–8 (1948) *In Russian.*—An alloy of 43% Ni, 56% Fe, 1% Cu under tensions > 5·6 kg/mm² sometimes showed large jumps of B as much as 3 minutes after a change of H. D. S.

538.24

5574. Elementary mechanisms of magnetization applied to initial magnetization. Guillaud, C. and Bertrand, R. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 8) 211–20 (1949) *In French.*—Expressions are deduced from the simple domain theory of magnetization giving the initial susceptibility due to rotation of the direction of magnetization of the domains and also due to movement of the boundary between domains magnetized parallel and anti-parallel to the field direction. Measurements have been made with monocrystalline Co and Mn_2Sb, separation of the mechanisms of rotation and boundary-movement being possible. Details of the magnetometer method used and the calibration techniques are given, with an estimate of the accuracy of the observations. Comparison of the experimental results with the calculations confirms the magnetization process by rotation and enables the effect of strains on the susceptibility to be evaluated. It is pointed out that the formula for magnetization due to boundary movement cannot be verified without hypotheses as to the shape of the domain. G. F. H.

538.242

5575. The effect of mechanical shock on magnetization and its temperature dependence. Gerlach, W. *Helv. Phys. Acta*, **22** (*No.* 2) 142–8 (1949) *In German.*—The increase of ferromagnetic magnetization due to mechanical shock in a constant field is discussed, and considered to be due to the effect of the elastic vibrations (associated with the shock) on the easy directions of magnetization. Experiments are described which show that the increase of magnetization is inversely proportional to the accompanying decrease of coercive field, and that it depends only on the initial magnetization, but is independent of temperature. D. S.

538.244.2 : 621.318.3

5576. Magnet coils. Coonrod, L. G., Cecconi, W. E., Gedraitis, C., Harper, K. R. and Lewis, R. M. *Rev. Sci. Instrum.*, **20**, 408–10 (*June*, 1949).—Methods of winding magnet coils using Cu tape as the current-carrying element are described. Difficulties with unsatisfactory arrangements are pointed out. One satisfactory system is described in detail, providing an efficient design for magnet winding to yield relatively high Cu cross-section while permitting the removal of heat at a high rate. A.

ELECTROMAGNETISM . ELECTRODYNAMICS
538.3/.5

538.54 : 621.3.014

5577. A study of eddy currents. Colombani, A. *J. Phys. Radium* (*Sér.* 8) **9**, 273–86 (*Nov.*, 1948) *In French.*—A study of the eddy currents induced by the field of an infinitely long solenoid in a concentric inner cylinder ring of finite length and of ferromagnetic conducting material. The wavelength of the electromagnetic oscillation is assumed large compared with the length of the inner tube which in turn is large compared with the tube diameter so that end-effects can be neglected. Flux, induced e.m.f., effective resistance and reactance, as well as the eddy-current losses and Q-factor are calculated as a function of the geometrical dimensions and the constants of the magnetic material. Some numerical results for different dust core materials are tabulated. The mathematical treatment is in terms of Bessel functions

and a table of numerical values for a certain combination of these functions is given for large arguments. The effect of the third harmonic is neglected. H. MO.

538.566

5578. Torque and angular momentum of radiation. CARRARA, N. *Nuovo Cim.*, **6**, 50–6 (*Jan.*, 1949) *In Italian.*—The angular momentum of circularly polarized electromagnetic waves ($\lambda = 3$ cm) was detected by means of the torque exerted both on an absorbing screen and on a device converting the polarization from circular to linear. The effect has the expected order of magnitude. L. P.

538.566

5579. Evanescent microwaves generated by diffraction. SCHAFFNER, M. AND TORALDO DI FRANCIA, G. *Nuovo Cim.*, **6**, 125–30 (*March*, 1949) *In Italian.*—A direct experimental proof is given of the existence of surface waves generated at a diffraction grating. The first order (evanescent) wave is transformed into an ordinary wave by refraction in a paraffin prism. The attenuation constant measured by varying the distance of the prism from the grating agrees with the theoretical value. L. P.

538.566 : 621.315.61.019.1

5580. Transmission properties of materials in the millimeter wave range. WANTUCH, E., ROHRBAUGH, J. H., COOLEY, J. P., GREIG, J. H. AND SHMOYS, J. Letter in *J. Appl. Phys.*, **19**, 1092–3 (*Nov.*, 1948).—Curves are given showing the transmission of waves in the range 0·3–2·2 mm for sheets of polystyrene and Teflon. The polystyrene transmits with little loss for wavelengths > about 1·3 mm. There is a marked absorption at shorter wavelengths. For Teflon the absorption curve shows 2 maxima and 2 minima in the range considered. W. T. B. (R)

538.566 : 621.392.26

5581. A note on reflection from dielectric structures in wave guide. SHMOYS, J. Letter in *J. Appl. Phys.*, **19**, 797 (*Aug.*, 1948).—The effect of a dielectric obstacle can be considered as a capacitive loading of a transmission line. If the obstacle is so small that $(K_e - 1)S \ll a\lambda$ (where K_e = permittivity, S = area of the obstacle, a = width of the guide and λ = free space wavelength) then as a first approximation it may be assumed that the geometry of the electric field is undisturbed. The effect of the obstacle can then be obtained by summation from the equation $dC = \varepsilon_0(K_e - 1)\sin^2(\pi x/a)(dS/b)$ where ε_0 = permittivity of free space and b = height of the guide. In the case of a block extending the full width of the guide, an exact solution is possible which agrees well with the approx. result. W. T. B. (R)

538.566 : 621.392.26

5582. Notes on the excitation of electromagnetic waves in cylindrical metallic wave guides. COLINO, A. *J. Appl. Phys.*, **20**, 576–7 (*June*, 1949).—Very simple formulae are deduced for calculating the amplitude of modes produced in a cylindrical guide when the current distribution is known. One example is included. A.

538.566 : 621.396.11

5583. On the diffraction of a plane wave by a semi-infinite conducting sheet. HORTON, C. W. Letter in *Phys. Rev.*, **75**, 1263 (*April* 15, 1949).—Approximate formulae are given for the part of the diffraction field not already covered by well-known approximations derived from Sommerfeld's solution. The new formulae are useful when radar frequencies are considered. A. T. P.

538.566 : 621.396.11

5584. The propagation of electromagnetic waves over the ground. Solution of the problem of the surface wave. KAHAN, T. AND ECKART, G. *J. Phys. Radium*, **10**, 165–76 (*May*, 1949) *In French.*—A critical survey is made of the classical analyses of Sommerfeld and of Weyl concerning ground wave signal intensity from a radiating dipole. A new treatment of the problem, resolving some of the obscurities of earlier work, is given. The work of Epstein on the possibility of obtaining a unique solution is also considered. W. J. G. B.

538.566 : 621.396.11 : 523.531

The diffraction of radio waves from meteor trails. *See Abstr.* 5213

538.566.2 : 621.396.11

5585. Radio superrefraction in the coastal regions of Australia. KERR, F. J. *Aust. J. Sci. Res. A*, **1**, 443–63 (*Dec.*, 1948).—A survey has been made based on the systematic reporting of the strengths of echoes from ground objects observed by 200 Mc/s radar stations. Observations taken hourly over periods of up to 18 months have been analysed in terms of geographical position, season of year, time of day, and synoptic weather situations. The main points arising from the analysis are: (i) The frequency of occurrence of super-refraction at different times and places has been determined; (ii) super-refraction is strongest and most regular in north-west Australia (occasional very long-range echoes occur in this region); (iii) in coastal Australia it is associated with one general condition, the offshore movement of a relatively warm and dry air mass; and (iv) super-refraction on inland echoes is due almost exclusively to night-time radiation inversions. A.

538.566.3 : 551.510.535 : 621.396.11

5586. Ionospheric radio propagation. *Circ. U.S. Bur. Stand.* (*No.* 462) 209 *pp.* (1948).—A comprehensive presentation of the principles of ionospheric radio wave propagation at 0·5–30 Mc/s with particular reference to radiocommunication. Topics dealt with include the theory of radio wave propagation, measurement techniques, structure of the ionosphere, spatial and temporal variations in the ionosphere, ionospheric storms, absorption of radio waves, atmospheric radio noise, calculation of m.u.f.'s and lowest useful h.f.'s. W. J. G. B. (R)

538.566.3 : 551.510.535 : 621.396.11

5587. Deviation at vertical incidence in the ionosphere. COTTE, M.; MILLINGTON, G. Letter in *Nature, Lond.*, **163**, 810 (*May* 21, 1949).—Calls attention to earlier work [COTTE, *C.R. Acad. Sci.*, **222**, 605 (1946)] on the subject of the deviation of the magneto-ionic components in vertical incidence radio sounding of the ionosphere. [See also Abstr. 3354 (1949)]. W. J. G. B.

538.566.3 : 551.510.535 : 621.396.11

5588. Critical-frequency difference variations and the Poynting vector in the ionosphere. SCOTT, J. C. W.

Letter in *Nature, Lond.*, **163**, 993 (*June* 25, 1949).—Observations, made in Canada, of the diurnal variations in the F_2-layer normal incidence critical frequency separation ($f^x - f^0$) can be explained in terms of changes in the positions of the reflection points of the two magneto-ionic components. W. J. G. B.

538.566.3 : 621.396.11

5589. Space variation in the field intensity of signals reflected by the ionosphere, in the absence of absorption. LEJAY, P. AND LEPECHINSKY, D. *C.R. Acad. Sci., Paris*, **227**, 997–1000 (*Nov.* 15, 1948) *In French.*—A graphical method is given for deducing the oblique incidence (P', f) curve from any given normal incidence curve. The method is strictly only applicable to the case of a plane earth and ionosphere. It is applied to a consideration of interference phenomena near the edge of the "skipped zone" and to the general law governing the relation between signal intensity and distance of transmission in the absence of ionospheric absorption. W. J. G. B. (R)

538.566.3 : 621.396.11

5590. Plane waves in an ionized gas with static electric and magnetic fields present. BAILEY, V. A. *Aust. J. Sci. Res. A*, **1**, 351–9 (*Dec.*, 1948).—General equations are derived which specify such waves in a first approximation when their amplitudes are small. The equation of condition (i.e. the equation of dispersion) is deduced and the nature of its roots is discussed. It is shown that under suitable conditions some of the roots lead to wave-groups which grow as they progress and others lead to waves which everywhere grow in time. The theory includes as special cases many of the results previously obtained for radio-propagation, "plasma" oscillations, and the like. Applications are indicated to electric oscillations and noise in discharge tubes, and to cosmic noise. A.

538.569.3

5591. Absorption of 12·5 mm wavelength electromagnetic radiation in supercooled water. BOWERS, R. AND MENDELSSOHN, K. Letter in *Nature, Lond.*, **163**, 871–2 (*June* 4, 1949).—The absorption of 12·5 mm waves in supercooled H_2O has been measured using a waveguide method, the lowest temp. at which a measurement was made being − 7°C. A graph shows the absorption coeff. in the range − 7°C to 46°C. There is no sign of a discontinuity at 0°C. W. T. B.

MAGNETIC EFFECTS 538.6

538.632

5592. On the sign of the Hall effect. ALTIERI, N. AND CARRELLI, A. *Nuovo Cim.*, **6**, 176–9 (*May*, 1949) *In Italian.*—Experiments on Te–Bi alloys showed that increasing the Bi content from 0 to 10% decreases the Hall constant by a factor of ~ 250, the resistivity by a factor of ~ 3, and the temperature coefficient of resistance by a factor of ~ 10. L. P.

538.652

5593. Metastable states of Ni. KNIGHT, J. J. Letter in *Nature, Lond.*, **163**, 839–40 (*May* 28, 1949).—A laminated bar of cold rolled Ni showed an increase in magnetostriction coeff. following rapid temp. changes. This metastable state can be maintained for days. The effect was absent in Ni alloys: similarity to observations by Snoek and Fast on initial permeability is noted. [See Abstr. 3383 (1948)]. N. F. A.

538.652 : 621.318.22

5594. Magnetostriction of Fe–Pt alloys. AKULOV, N. S., ALIZADE, Z. I. AND BELOV, K. P. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 6) 815–18 (1949) *In Russian.*—3 Fe–Pt alloys with 54, 56 and 58% Pt-content, respectively, were prepared by smelting and drawn into wires which were tested for magneto-striction properties by a strain gauge method. By graphical integration of the test curves the value $\lambda_\infty \sim 105 \times 10^{-6}$ was obtained for the effect in the 54% Pt alloy. The effect was found to be $> 2\times$ the effect for Ni and + ve, and was confirmed by the great magnetic sensitivity of the alloy to elastic deformations. Annealing the alloy at 740° after tempering at 900°C considerably increases the effect, simultaneously raising the saturation value of magnetization (though less conspicuously). Annealing increases the electrical conductivity by 6%. B. F. K.

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

5595. The partition function of a one-dimensional model of condensed state. MUTO, Y. *Proc. Phys.-Math. Soc. Japan*, **24**, 54–9 (1942) *In English.*—A one-dimensional crystal is considered in which interatomic forces of a special type exist between the nearest neighbours. The exact partition function of the system was approximated by numerical calculations and the relation between the force constants and melting point was obtained. Finally the method was compared with other approximation methods. S. C. A. P.

539.11

5596. An application of perturbation theory to the polar model of a metal. BOGOLYUBOV, N. N. AND TYABLIKOV, S. V. *J. Exp. Theor. Phys., USSR*, **19**, 251–5 (*March*, 1949) *In Russian.*—A brief account of the results of one form of the perturbation theory for a degenerate level in its application to the polar model of a metal. These results were used for developing a simple method for using the results of the theory of excitations without recourse to the method of secular equations. B. F. K.

539.11 : 537.122 : 538.114

5597. Approximate method of finding the lowest energy levels of the electrons in metals. BOGOLYUBOV, N. N. AND TYABLIKOV, S. V. *J. Exp. Theor. Phys., USSR*, **19**, 256–68 (*March*, 1949) *In Russian.*—A method of secondary quantization for determining the energy spectrum of the weakly excited states. The results are illustrated by the example of the theory of ferromagnetism. It was established that a certain electric current is associated with the spin-waves. B. F. K.

MOLECULAR STRUCTURE 539.13

539.132

5598. Further contribution to the theory of hydrogen molecule. INUI, T. *Proc. Phys.-Math. Soc. Japan*, **23**, 992–9 (1941) *In English.*—The orbital function used for the ground state has the form:

$$\Psi(1, 2) = \psi_a(1)\psi_b(2) + \psi_a(2)\psi_b(1)$$

where $\psi_a(i) = \varepsilon^{-\alpha\xi_i - \beta\eta_i}$ and $\psi_b(i) = \varepsilon^{-\alpha\xi_i + \beta\eta_i}$ $(i = 1, 2)$, ξ and η being the spheroidal co-ordinates defined by the relations $\xi = (r_a + r_b)/R$, $\eta = (r_a - r_b)/R$ where R denotes the internuclear distance and r_a and r_b are the distances of an electron from the nuclei a and b. The energy-distance curve was re-determined directly for the range 1·0 to 1·7 Å without assumptions. S. C. A. P.

539.132

5599. Mean square angular momentum, rotational magnetic moment and diamagnetic susceptibility of the hydrogen molecule. INUI, T. *Proc. Phys.-Math. Soc. Japan*, **23**, 999–1010 (1941) *In English.*—Mean square angular momentum $\langle L^2 \rangle$ of the normal H molecule and rotational magnetic moment μ_R were calculated by use of the wave function

$$\Psi(1, 2) = 2\varepsilon^{-\alpha(\xi_1 + \xi_2)} \cosh \beta(\eta_1 - \eta_2)$$

where ξ_i, η_i are spheroidal co-ordinates of the i-th electron $(i = 1, 2)$ and α, β are variation parameters [see preceding Abstr.]. The results are as follows: $\langle L^2 \rangle = 0{\cdot}390$ Å, $\mu_R = 0{\cdot}81$ nuclear magneton, and susceptibility $\chi_{mol} = -3{\cdot}805 \times 10^{-6}$ c.g.s. S. C. A. P.

539.132

5600. Notes on the molecular orbital treatment of the hydrogen molecule. COULSON, C. A. AND FISCHER, I. *Phil. Mag.*, **40**, 386–93 (*April*, 1949).—The fundamentals of the method, in the form using a linear combination of atomic orbitals, are studied more closely than before. The ground state and several excited states of H_2 are considered. The failure at large internuclear distances in the ground state, and the over-emphasis on ionic terms are discussed. L. S. G.

539.132

5601. Resonance and molecular structure. TORKINGTON, P. Letter in *Nature, Lond.*, **163**, 446 (*March* 19, 1949).—Ideal hybrid bonds of quantum mechanics are only found where the symmetry of the bonded system is identical with that of hybridized atomic orbitals. Any asymmetry appears to cause the angles between the bonds to deviate from the ideal values and these small, though real, deviations indicate that these asymmetric systems are resonance hybrids. This view is tested for methyl halides, fluorinated ethylenes, formaldehyde and phosgene. There is some evidence that bond directions may be inclined at an angle to the line joining the nuclei of bonded atoms. W. R. A.

539.132

5602. Dissociation energy of carbon monoxide. HOWELL, H. G. Letter in *Nature, Lond.*, **163**, 773 (*May* 14, 1949).—A short linear extrapolation of the vibrational levels of the $F\,^1\Pi$ state of CO favours a value of 9·6 eV for the dissociation energy. A. G. G.

539.132 : 535.343.2–15

5603. Vibrations of an infinitely long chain of CH_2-groups and the infra-red spectrum of polythene. KELLNER, L. Letter in *Nature, Lond.*, **163**, 877 (*June* 4, 1949).—Fundamental frequencies of polythene are calculated agreeing with the observed spectrum, by treating $-CH_2-CH_2-$ as if it were a crystal unit. D. H. W.

ATOMIC STRUCTURE . ISOTOPES 539.15

539.152

5604. On spins, moments, and shells in nuclei. NORDHEIM, L. W. *Phys. Rev.*, **75**, 1894–901 (*June* 15, 1949).—Known values of nuclear spins and magnetic moments are used to assign orbital quantum numbers to the last odd particle. A consistent scheme is developed that permits the correlation of a wide variety of nuclear data. An interpretation is obtained of the general trends of nuclear spins, for the particular stability of nuclei containing 20, 50 or 82 neutrons or protons, for the occurrence of isomeric states, and for the allowed or forbidden character of β-decays for nuclei with odd mass numbers. A.

539.152.1

5605. A liquid model of atomic nuclei. NAGAMIYA, T. AND NOGUCHI, T. *Proc. Phys.-Math. Soc. Japan*, **24**, 306–12 (1942) *In English.*—Heavy atomic nuclei was treated under the assumption that each particle in them is vibrating in a cell formed by its neighbours. An average interaction potential, similar to that acting between two atoms or molecules, was assumed to exist between any two nuclear particles and the liquid theory of Lennard-Jones and Devonshire was used to calculate the binding energy and the radius of the nucleus. The results agree with experiments as far as the order of magnitude is concerned. S. C. A. P.

539.152.1

5606. On a shell model of the atomic nucleus. EHRENBERG, W. *Z. Naturforsch.*, **4a**, 70–4 (*April*, 1949) *In German.*—A model is developed which gives the observed stability maxima in the nuclear series, and the limits of stability of series of isotopes. G. J. K.

539.152.1

5607. Meson exchange and spin-orbit coupling in nuclei. INGLIS, D. R. Letter in *Phys. Rev.*, **75**, 1767–8 (*June* 1, 1949).—A graphical description of the meson interaction is used to argue the possibility of a spin-orbit coupling of nucleons sufficiently large to give a suggested *j-j* coupling model of nuclei. G. J. K.

539.154 : 621.317.733

5608. Amplitude bridge for detection of nuclear resonance. THOMAS, H. A. AND HUNTOON, R. D. *Rev. Sci. Instrum.*, **20**, 516–17 (*July*, 1949).—A circuit for detecting nuclear resonance absorption is described which, unlike the r.f. bridge, is simple to construct and adjust and very insensitive to microphonics. The voltages in two branches of an r.f. network, one of which contains the coil and sample, are rectified by diode detectors and the audio outputs

combined in such a way that noise modulation from the r.f. generator is balanced out but the desired signal is not. Experimental performance is discussed and typical s./n. ratios are given. A.

539.155

5609. Energy levels in Ca^{41} and the mass difference between A^{40} and Ca^{40}. SAILOR, V. L. *Phys. Rev.*, **75**, 1836–9 (*June* 15, 1949).—The reaction $Ca^{40}(d,p)Ca^{41}$ was studied and Q-values of 6·17, 4·22, 3·76, 2·31 MeV were found. 4 additional Q-values 3·2, 2·9, 2·7, 2·5 MeV are probable. The mass increment $(A^{41} - A^{40}) - (Ca^{41} - Ca^{40}) = 2·54 \pm 0·03$ mMU was obtained by comparing the end groups of the two reactions $A^{40}(d,p)A^{41}$ and $Ca^{40}(d,p)Ca^{41}$. These data combined with data from two other nuclear reactions give the mass difference $Ca^{40} - A^{40} = 0·27 \pm 0·21$ mMU, indicating that A^{40} is slightly more stable than Ca^{40}. This mass difference is compared with data on the radioactive decay of K^{40}, showing that the assignment of the 1·55-MeV γ-ray to $K^{40} \rightarrow A^{40}$ K-capture process is reasonable. A.

539.155.2

5610. On the abundances of the zirconium isotopes. HINTENBERGER, H. *Z. Naturforsch*, **4a**, 76 (*April*, 1949) *In German.*—These were measured in a Nier-type spectrometer, and differ somewhat from Aston's values [Abstr. 1904 (1935)], but agree well with later work [Abstr. 670 (1949)]. B. R.

539.155.2

5611. Search for stable Pd^{100}, W^{178} and Pb^{202}. DUCKWORTH, H. E., BLACK, R. F. AND WOODCOCK, R. F. Letter in *Phys. Rev.*, **75**, 1616–17 (*May* 15, 1949).—Upper limits of abundance of 0·0007%, 0·001% and 0·004%, respectively, are assigned to these isotopes by mass-spectrometric measurements. B. R.

539.155.2

5612. A new regularity in the abundance distribution of isotopes: the N_4-effect. MONECKE, O. *Experientia*, **5** (*No.* 6) 232–3 (1949) *In German.*—The two groups of nuclei (A, Z, even and A, Z, odd) with an even number of neutrons, N, each split up into two classes for which $N = 4n$, $N = 4n + 2$; the latter are considerably more abundant (stable). It is concluded that these nuclei contain shells of 4 particles (N_4-layers). A. O. S.

539.155.2 : 536.48 : 531.19

5613. Possible experimental verification of the statistics of He^3. TER HAAR, D. Letter in *Phys. Rev.*, **75**, 1444–5 (*May*, 1949).—Whereas with He^4 the effect of the statistics on the second virial coefficient B only becomes appreciable at temperatures where the vapour pressure is too low for an accurate determination of B, the conditions are more favourable for He^3 because, owing to the smaller mass, the effect is larger and the vapour pressure is higher. H. L.

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16.08

5614. Measurement of P^{32} and I^{131} radiations with dental film. RUDENBERG, F. H., COWRING, R. F. AND SPALDING, C. K. *Nucleonics*, **3** (*No.* 6) 52–9 (*Dec.*, 1948).—A series of measurements was made on the degree of blackening produced in dental films by exposures of various times at various distances from sources of P^{32} (β) and I^{131} ($\beta + \gamma$). The absolute dose rates were measured by a Geiger counter and an air ionization chamber. Curves of blackening $v.$ dosage in roentgens were obtained. It was concluded that an estimate of dosage from a measurement of film blackening is accurate to ± 20%. A. P. F.

539.16.08

5615. Surveying and monitoring of radiation from radioisotopes. MORGAN, G. W. *Nucleonics*, **4**, 24–37 (*March*, 1949).—A practical guide, giving tables of approx. radiation levels and permissible doses for β- and γ-sources of various strengths, and listing the types of detecting apparatus and their ranges of application. Methods of survey in the neighbourhood of a source are outlined. The monitoring of laboratory operations, equipment and personnel is described at some length, and illustrated with photographs. A. P. F.

539.16.08

5616. Absorption of alpha rays in thick sources. BEHARRELL, J. *Trans. Amer. Geophys. Un.*, **30**, 333–6 (*June*, 1949).—The radioactivity of rocks is normally measured by counting the α particles emitted from a powdered sample. The number emitted depends upon the absorption factor of the rock so this must be evaluated before the radioactivity can be accurately known. The various methods of arriving at the absorption factor are discussed and it is suggested that there are errors both in the values proposed by Nogami and Hurley and also in that formerly used in the laboratory of the University of Toronto. Mention is made of the further work that is required in order to arrive at an accurate value. A.

539.16.08 : 537.542

A precision automatic electrometer. *See Abstr.* 5500

539.16.08 : 615.849

5617. The accuracy of standard radium preparations. KREMENAK, B. *Acta Phys. Austriaca*, **2** (*Nos* 3–4) 299–311 (1949) *In German.*—Weiss queried the accuracy of standard Ra preparations and drew the conclusion that discrepancies arise with earlier prepared and later prepared standards. Hönigschmid gave a limit of inaccuracy of 0·2%. Using a Curie plate condenser and a Wulf electrometer the present author has carried out comparisons of standards used in the Vienna Institute for Radium Investigation, three such standards being mutually compared and then used with two non-standard preparations. Experiments were also conducted to discover the cause of the variations found by Weiss. The results show possible errors of ± 0·2% between primary standards which extended to ± 0·5% with sub-standards. B. J. L.

539.162 : 539.172.4

5618. The equations of radioactive transformation in a neutron flux. RUBINSON, W. *J. Chem. Phys.*, **17**, 542–7 (*June*, 1949).—The standard equations of radioactive transformation are generalized to include the case where radioactive nuclei are subject to transformation by neutron absorption in addition to spontaneous decay. Opportunity is taken to derive

the equations by a simple method which avoids recourse to the formal methods of solving differential equations. A method is pointed out whereby one may write simply by inspection the equation for the activity of a species which is descended from an ancestral species through a chain of any combination of decays and neutron absorptions. Some problems are solved as illustration. A.

539.163

5619. Disintegration schemes and the coincidence method. MANDEVILLE, C. E. AND SCHERB, M. V. *Nucleonics*, **3** (*No.* 4) 2–12 (*Oct.*, 1948).—A general account is given, with illustrative examples, of the principles and techniques used in analysing decay schemes by a study of β–β, β–γ and γ–γ coincidences. The use of γ-counters with walls of low Z is commended, despite their low efficiency, because of their nearly linear energy-efficiency relationship [Abstr. 1658 (1948)]. See also Abstr. 2542 (1948). A. P. F.

539.163

5620. Decay of thulium-170 and rhenium-186. GRANT, P. J. AND RICHMOND, R. Letter in *Nature, Lond.*, **163,** 840 (*May* 28, 1949).—β- and γ-ray energies are presented, derived from absorption and coincidence measurements and lens spectroscopy. B. R.

539.163.1

5621. On the question of the 3·3 h activity of terbium. FLAMMERSFELD, A. *Z. Naturforsch.*, **4a,** 75–6 (*April*, 1949) *In German.*—This is shown to be due to Dy contamination, by showing the presence of the 1·25 min activity of Dy. The ½-life is found to be 2·5 ± 0·1 hr [Abstr. 1950 (1938)]. B. R.

539.163.1

5622. The half-life of radiocarbon (C^{14}). ENGELKEMEIR, A. G., HAMILL, W. H., INGHRAM, M. G. AND LIBBY, W. F. *Phys. Rev.*, **75,** 1825–33 (*June* 15, 1949).—The ½-life of C^{14} has been found to be 5 720 ± 47 yr by means of the use of mass spectrometrically analysed $C^{14}O_2$ as a part of the counter gas in brass wall G.M. counters. Some of the problems of absolute β-counting with internal counters have been investigated, particularly the coincidence and end corrections. A.

539.163.1

5623. Nitrogen 12. ALVAREZ, L. W. *Phys. Rev.*, **75,** 1815–18 (*June* 15, 1949).—N^{12} is shown to have a ½-life of 12·5 ± 1 msec, and a positron upper limit of 16·6 ± 0·2 MeV. It is produced by the reaction $C^{12}(p, n)N^{12}$, and has a threshold proton energy of 20·0 MeV. This indicates that N^{12} is within about 200 keV of being unstable against proton emission. The mass of N^{12} is 12·0228 ± 0·00015, and the β-transition is allowed. A.

539.163.2

5624. On the existence of the β-branching of RaA and of the isotope 218 of radon. WALEN, R. J. *J. Phys. Radium* (*Sér.* 8) **10,** 95–103 (*March*, 1949) *In French.*—A study of the active deposit of Rn using a proportional amplifier comfirm the existence of the 6·7 MeV α-particle group attributed to At^{218} [Abstr. 1900 (1948)] and indicates a further branching ($\beta/\alpha \sim 1/1\,000$) at At^{218}, leading to Rn^{218}, an α-emitter with a ½-life of 1·3 sec. [But see also Abstr. 1136 (1949)]. A. O. S.

539.163.2

5625. On the absolute intensities of radiations emitted by Cu^{61} and Cu^{64}. BOUCHEZ, R. AND KAYAS, G. *J. Phys. Radium* (*Sér.* 8) **10,** 110–19 (*April*, 1949) *In French.*—The *K*-capture/positron emission ratio ρ was found to be 2·65 ± 0·4 and 0·55 ± 0·06 for Cu^{64} and Cu^{61} respectively, by measurement of the absolute intensities of X-radiation in a thin-walled Geiger counter and annihilation radiation in an ion chamber. ρ_{64} is in reasonable agreement with theoretical prediction, but not ρ_{61}. The ratio ρ_{64}/ρ_{61} agrees with earlier measurements [Abstr. 827 (1946)]. The period of Cu^{61} was found to be 3·35 ± 0·1 hr. B. R.

539.163.2

5626. Investigation of soft radiations by proportional counters. III. The beta spectrum of carbon 14. ANGUS, J., COCKCROFT, A. L. AND CURRAN, S. C. *Phil. Mag.*, **40,** 522–30 (*May*, 1949).—The spectrum was studied for energies in the range from about 5 keV to 157·5 keV. The spectrum appears to be simple, but considerable departures from the Fermi distribution are found. The distribution has a pronounced maximum at about 40 keV and falls sharply to zero intensity at lower energies. Considerations of ½-life and energy limit, and the shape of the spectrum in the low energy region suggest better agreement with the Fermi selection rules than with those of Gamow–Teller. L. S. G.

539.163.2

5627. Investigation of soft radiations by proportional counter. IV. The beta spectrum of Ni^{63}. WILSON, H. W. AND CURRAN, S. C. *Phil. Mag.*, **40,** 631–6 (*June*, 1949).—Some metallic Ni was irradiated for a few months in a pile and allowed to stand for 6 months. The main activity was that of Co^{60}, but careful chemical separation yielded active Ni which was converted to Ni carbonyl by the action of CO at 80°c. The carbonyl was decomposed by heating and a very thin layer of Ni was deposited on an Al foil. The spectrum of the soft β-source so obtained was studied. The process is likely to be $Ni^{63} \rightarrow Cu^{63} + \beta^-$. The absorption curve of the negative β-particles was determined. The life of Ni^{63} is at least 15 yr and a precise value is now being determined. L. S. G.

539.163.2

5628. Decay of 8-day iodine^{131} to a metastable state of xenon^{131}. BROSI, A. R., DEWITT, T. W. AND ZELDES, H. Letter in *Phys. Rev.*, **75,** 1615–16 (*May* 15, 1949).—Absorption and coincidence experiments indicated a state of Xe^{131*} of energy ~ 165 keV above the ground state, ½-life 12 days, and internal conversion coefficient ~ 20. B. R.

539.163.2

5629. The disintegration scheme of cerium (141). MANDEVILLE, C. E. AND SHAPIRO, E. *Phys. Rev.*, **75,** 1834–6 (*June* 15, 1949).—The β-rays of Ce^{141} have a max. energy of 0·44 MeV. An absorption curve in Pb of the γ-radiation yields a quantum energy of 0·13 MeV. This γ-ray is coincident in time with the β-ray spectrum. β-β-coincidences are present in the disintegration of Ce^{141}, showing that the γ-ray is to some extent converted. The β-rays of Pr^{143} have a max. energy of 0·835 MeV. A.

539.163.2

5630. Gamma-rays from tantalum 182. CORK, J. M., KELLER, H. B., SAZYNSKI, J., RUTLEDGE, W. C. AND STODDARD, A. E. Letter in *Phys. Rev.*, **75**, 1778–9 (*June* 1, 1949).—Re-examination of the β-ray lines of Ta^{182} [see Abstr. 3628 (1947)] with a photographic β-spectrometer gave 48 electron lines which can be assigned to 28 γ-rays. A possible level scheme for W^{182}, with 13 levels, is suggested. A. O. S.

539.163.2 : 539.166

5631. The gamma-rays of W^{187} in the low energy region. BEACH, L. A., PEACOCK, C. L. AND WILKINSON, R. G. Letter in *Phys. Rev.*, **75**, 211 (*Jan.* 1, 1949).—The electron spectrum was measured down to 3 keV in a 180° spectrometer, showing lines at 57, 66, 127 and 136 keV. These are interpreted in terms of γ-rays of energy 78 and 138 keV. A disintegration scheme is suggested from these and previous results [Abstr. 1152 (1949)]. B. R.

539.164

5632. Recent progress in alpha-ray spectroscopy. ROSENBLUM, S. *Nucleonics*, **4**, 38–42 (*March*, 1949).—A brief description is given of the Bellevue permanent magnet, which can produce a field of 12 500 gauss over a 2 cm gap, the pole-piece diameter being 120 cm. α-particles with $H\rho \leqslant 400\,000$ can be studied. Spectra are obtained by receiving the α-particles on nuclear photographic emulsions; the high sensitivity enables long-lived emitters to be studied. It is claimed that energy differences of 3 keV in 6 MeV can be detected under favourable circumstances. Samples of spectral analyses are shown. A. P. F.

539.164

5633. Stepping power of liquid water for α-particles. APPLEYARD, R. K. *Nature, Lond.*, **163**, 526 (*April* 2, 1949).—α-particles from an aqueous solution of Po in 0·5–1·5 *N* HCl were counted in a thin-window Geiger counter. The stopping power of the H_2O was compared to that of the laboratory air by varying the height of the counter above the liquid surface. A value of 1·71 (to an estimated $\pm$ 5% accuracy) was obtained for the ratio of the atomic stopping power of H_2O to that of air for 4–5 MeV α-particles. This ratio is 13% > the value predicted by the Bragg law. L. R. S.

539.164

5634. A new method of measuring the stopping power of several materials for alpha-particles. HAMMER, F. E. AND HOECKER, F. E. *Rev. Sci. Instrum.*, **20**, 394–8 (*June*, 1949).—The application of an atmospheric pressure α-particle detector to the measurement of the relative stopping power of thin films of absorbing material for α-particles was investigated. The air-equivalent of absorbing films was measured directly by balancing the counting rates of two detectors in air, and again when an absorbing film is inserted between one of the detectors and its source. Measurements of the air-equivalent and relative stopping powers of films of mica, polystyrene, and Al are given. The relative stopping powers determined agree well with previous values. The errors of the method are discussed and an attempt is made to specify the magnitude of the probable error in the result. A.

539.164 : 537.542

Determination of energy of single alpha-particles from change in conductivity of cadmium sulphide crystals. *See Abstr.* 5489

539.164.08 : 532.623

5635. Detection of α-particles by the destruction of soap bubbles. CHAMINADE, R. *C.R. Acad. Sci., Paris*, **228**, 480–1 (*Feb.* 7, 1949) *In French.*—Po α-particles were observed to burst bubbles $\sim$ 1 mm diameter in a soap foam. The efficiency, defined as the number of bubbles burst per α, was $0{\cdot}1 \pm 0{\cdot}05$. The range of the α's, as measured by the radius of the hemispherical cavity produced in the foam by a point source, was $3{\cdot}8 \pm 0{\cdot}1$ cm, in good agreement with other determinations. B. R.

539.164.2

5636. The angular correlation of short range α-particles and γ-quanta. KULCHITSKI, L. A., LATYSHEV, G. D. AND BULYGINSKI, D. G. *Dokl. Akad. Nauk, SSSR*, **64** (*No.* 1) 57–60 (1949) *In Russian.*—Chang [Abstr. 1682 (1946), 964 (1947)] showed experimentally that short range α-particles from Po and Ra were about 1 000× more intense than indicated by the Geiger–Nuttall law. A. B. Migdal, who suggested the present work, proposed that α-active nuclei may exhibit surface oscillations, the resulting deformation of the nucleus leading to a decrease in the potential barrier in certain directions, increasing the probability of α-emission; the direction of γ-emission would also depend on the character of the oscillations. Coincidences between α and γ counts were measured for 9 different angles (from 0° to 180°) between the α and γ counters; the true coincidences were only from 5 to 10% of the total coincidences recorded (about 8 000 at each angle). Since the source was an approximately 50–50 mixture of RdTh and ThC, only qualitative conclusions were drawn, viz. there are correlation maxima at 45° and 135°, with subsidiary maxima at 0° and 180°, minima occur at $\sim$ 30°, 90° and 150°. J. C. E. J.

539.165

5637. Theory of β-disintegration realizable by Bose particles heavier than heavy particles. TANIKAWA, Y. *J. Phys.-Math. Soc. Japan*, **17**, 597–602 (1943).—It is pointed out that the Fermi theory of β-disintegration and that due to meson theory, which is equivalent to the former, are not satisfactory not only quantitatively but also qualitatively. Hence, efforts were made to obtain a new theory which would give different selection rule and electron distributions from the usual ones. For this purpose Bose particles with positive or negative charge (spin 0 or 1) are introduced, the mass of which must be > the heavy particles. The lifetime of this "heavy meson" is about 10^{-16} sec. If its mass is taken close to heavy particles, the lifetime becomes much less than this. S. C. A. P.

539.165

5638. Radioactive silver isotopes produced by photodisintegration of cadmium. DUFFIELD, R. B. AND KNIGHT, J. D. Letter in *Phys. Rev.*, **75**, 1613 (*May* 15, 1949).—The 5·3 hr and 20 min activities were assigned to Ag^{113} and Ag^{115} respectively by bombardment of enriched Cd isotopes. β-endpoints of

$2 \cdot 1 \pm 0 \cdot 2$ MeV and 3 MeV resp. were measured by absorption methods. A 2 min β^- activity produced by fast neutrons on Cd^{114} was assigned to Ag^{114}. B. R.

539.165.2

5639. Neutrinos from P 32. Sherwin, C. W. *Phys. Rev.*, **75**, 1799–1810 (*June* 15, 1949).—Sources of P^{32} which come close to being true monolayers are prepared by evaporation in a vacuum. The characteristics of these sources are maintained for 5 to 10 d with the aid of radiant heating. Surface charges are neutralized by periodic "baths" of thermal electrons. The momentum of the electrons is measured with a magnetic spectrometer and the momentum of the recoil ions is measured by observing their time of flight in a field free space. The momentum measurements show that the missing momentum disappears in one package. Separate energy measurements determine the amount of energy which disappears. The observed ratio of the missing energy to the missing momentum is equal to the velocity of light ($\pm 20\%$), as required by the hypotheses that one neutrino is emitted in β-decay. After experimentally determined corrections are made for the effects of surface scattering of the recoil ions, it is concluded that the missing momentum vector (i.e. the neutrino) most probably enters the same hemisphere as the electron. The experimental points fit best on a curve of the form, $(1 + v/c \cos \theta)$. This is in disagreement with previous tentative conclusions by the author which are not shown to be in error due to surface losses and scattering of the recoil ions. A.

539.165.2

5640. Demonstration of the influence of the degree of ionization of the atom on the period of the nuclide Be^7. Bouchez, R., Daudel, P., Daudel, R., Muxart, R. and Rogozinski, A. *J. Phys. Radium*, **10**, 201–6 (*June*, 1949) *In French.*—A continuation of previous work [Abstr. 285 (1949)]. By the use of two balanced ionization chambers, a difference of between 0·7% and 1·3% has been demonstrated in the periods of a metallic Be^7 source and a source of Be^7F_2, in agreement with a simple theory. B. R.

539.165.8

5641. Theoretical remarks on Crane and Halpern's experimental evidence for the existence of the neutrino. Ingarden, R. S. *Acta Phys. Polon.*, **9** (*Nos* 2–4) 109–21 (1947–48) *In English.*—The number of molecules dissociated by the nuclear recoil is calculated. The clusters of droplets observed are ascribed to ionization produced by photons carrying away the excess electronic binding energy of A^{38} over Cl^{38}. It is concluded that the experiment establishes non-conservation of momentum between the β^- and the nucleus [Abstr. 3622 (1939)]. B. R.

539.166

5642. Gamma rays and internal conversion. Cork, J. M. *Nucleonics*, **4** (*No.* 1) 24–34 (*Jan.*, 1949).—After a general discussion of precision methods in β-spectrometry, the results are given of a series of measurements with a double-focusing spectrometer on photo- and internal conversion electrons from isotopes formed by neutron capture or excitation (24 elements in all). A. P. F.

539.166 : 614.8

Gamma-ray shielding data. *See Abstr.* 5831

539.167

5643. Review of conventions in radiotracer studies. Schulman, J., Jr. and Falkenheim, M. *Nucleonics*, **3** (*No.* 4) 13–23 (*Oct.*, 1948).—On the basis of a study of papers (155 refs.) on biological applications of tracers, suggestions are made for expressing results in the most convenient form. A conversion table is given by which results expressed in various forms in the literature may be related. A. P. F.

539.167.3 : 578

Use of radioactive tracers in biological research. *See Abstr.* 5824–5

NUCLEAR REACTIONS 539.17

539.17 : 537.591.8

5644. On the cosmic-ray stars. Fujimoto, Y. and Yamaguchi, Y. Letter in *Phys. Rev.*, **75**, 1776–7 (*June* 1, 1949).—The excess of slow protons (< 7 MeV) produced in cosmic-ray stars, over the number to be expected from the evaporation process, is attributed to proton emission from proton-rich residual nuclei after evaporation has taken place, for which a lifetime $\ll$ that of alternative mechanisms is estimated. J. G. W.

539.17 : 778.3

5645. On a new method of the study of disintegrations producing two ionizing particles in photographic plates. Chastel, R. *C.R. Acad. Sci., Paris*, **228**, 1725–7 (*May* 30, 1949) *In French.*—In the reaction $Li^6(n,H^3)He^4$ two particles are emitted in opposite directions, and it is usually difficult to determine the point of origin of the disintegration in the photographic emulsion. The actual lengths of both types of tracks can be evaluated by a statistical length measurement of tracks found close to the glass support of the emulsion, since the minimum length of the tracks due to the heavier particle must have been produced by a nuclear disintegration occurring at the bottom of the emulsion. The actual lengths are found from the difference of the total length of both tracks and the statistically significant length of the heavier particle. R. H. H.

539.17 : 778.3

The photographic emulsion in nuclear physics. *See Abstr.* 5848

539.172 : 537.591.8

Nuclear reactions of cosmic-ray particles. *See Abstr.* 5539–50

539.172 : 539.18

5646. The meson-disintegration of the deuteron. Marty, C. and Prentki, J. *J. Phys. Radium*, **10**, 156–64 (*May*, 1949) *In French.*—Expressions are obtained for the cross-sections of capture by deuterons of slow π-mesons, whether charged or neutral, pseudoscalar or vector. They are all of the order of 10^{-28} cm^2. This would not distinguish between types of mesons. The distribution of the emitted protons, for positive mesons, is very asymmetric. G. J. K.

539.172.1

5647. Long-range protons from the $He^3(d,p)\alpha$-reaction. HATTON, J. AND PRESTON, G. Letter in *Nature, Lond.*, **164**, 143–4 (*July* 23, 1949).—The above reaction was observed in the bombardment of heavy ice by He ions enriched to 4×10^{-3} in He^3 by thermal diffusion. One proton group only was observed, of range 300 mg/cm² Al. Any low energy groups of energy $< 2{\cdot}9$ MeV have intensity $< 1\%$ of the main group. The excitation curve from 80 to 180 keV followed a simple Gamow curve. B. R.

539.172.1 : 537.534

Instrumentation for nuclear studies with externally focused deuteron beam from ten-Mev cyclotron. *See Abstr.* 5476

539.172.11

5648. The emission of protons from boron and argon on bombardment with Po α-particles. ROY, R. R. Letter in *Phys. Rev.*, **75**, 1775–6 (*June* 1, 1949).—The angular distribution of protons from the reaction $B^{10}(\alpha,p)C^{13}$ was obtained from cloud-chamber measurements (86 proton tracks). The distributions for the 2nd and 3rd excited states are isotropic, so the interactions only involve an *S*-wave; there were insufficient tracks for the 1st excited state. With A bombarded by Po α-particles, no protons were observed in 300 photographs, confirming the negative results of Pollard and Brasefield [Abstr. 417 (1937)]. A. O. S.

539.172.13 : 537.534.74

5649. Beryllium–proton reactions and scattering. THOMAS, R. G., RUBIN, S., FOWLER, W. A. AND LAURITSEN, C. C. Letter in *Phys. Rev.*, **75**, 1612–13 (*May* 15, 1949).—The cross-sections of $Be^9(p,d)Be^8$, $Be^9(p,\alpha)Li^6$ and proton scattering by Be^9, have been measured for incident proton energies of 250–1 300 keV at a laboratory angle of 138°. The reaction particles were resolved in a 180° double-focusing magnetic spectrometer and recorded in an ionization chamber. In estimating α-particle yields, correction was made for unrecorded He^+ ions. Results have been compared with cross-sections of $Be^9(p,\gamma)B^{10}$ given by other authors. The (p,γ) resonance energies of 330 and 998 keV correspond to regions of anomaly in the scattering and reaction cross-sections. The scattering is also anomalous at the (p,γ) resonance energy of 1 087 keV but no corresponding effect occurs in the (p,γ) and (p,α) cross-sections, a result explained by assigning $J=0$ and even parity to this level in B^{10}. L. R. S.

539.172.3

5650. Cross section for the disintegration of the deuteron by 2·76 MeV γ-rays. WILSON, R., COLLIE, C. H. AND HALBAN, H. Letter in *Nature, Lond.*, **163**, 245–6 (*Feb.* 12, 1949).—Following earlier measurements with a RdTh source [Abstr. 3935 (1948)], experiments have been made under improved conditions with both RdTh and Na^{24} γ-ray sources. The ratio of photodisintegration cross-sections at 2·76 and 2·62 MeV is found to be $1{\cdot}05\pm0{\cdot}08$ absolute values $15{\cdot}6$ and $14{\cdot}8\times10^{-28}$ cm² respectively). The ratio predicted theoretically is 1·21 for meson mass 296 m_e, and 1·22 for meson mass 197 m_e. A. P. F.

539.172.4

5651. On the production, by a new nuclear reaction, of high energy deuterons by fast neutrons. CÜER, P., MORAND, M. AND VAN ROSSUM, L. *C.R. Acad. Sci., Paris*, **228**, 481–3 (*Feb.* 7, 1949) *In French.*—Evidence is presented for a reaction of the type *n* (high energy) + nucleus → *d* (high energy) + nucleus (low excitation), detected in photographic plates exposed in a Berkeley cyclotron. The theoretical implications of the reaction are discussed. B. R.

539.172.4

5652. Some recent advances in radiochemistry. EMELÉUS, H. J. *Nature, Lond.*, **163**, 624–6 (*April* 23, 1949).—A review dealing with the chemical separation of the fission products of U and other fissile elements, the fitting of new radioactive isotopes of the heavy elements into modifications of the classical decay series, and the chemistry of the transuranic elements, neptunium, plutonium, americium and curium, and that of elements of atomic numbers 87 (francium), 85 (astatine), 61 (illinium or prometheum) and 43 (masurium or technetium). A. J. M.

539.172.4

5653. Charged particles emitted by carbon bombarded by 90-Mev neutrons. BRUECKNER, K. AND POWELL, W. M. Letter in *Phys. Rev.*, **75**, 1274–5 (*April* 15); *erratum*, 1970 (*June* 15, 1949).—Charged particles ejected from C nuclei by 90 MeV neutrons were studied in a 22 in cloud chamber, with 21 700 gauss magnetic field. Identification of the particles emitted from the C target was accomplished by measuring the track curvatures on both sides of a glass absorber. Protons from 32 to 107 MeV, deuterons from 25 to 124 MeV and tritons from 56–95 MeV, were identified within an angle of 36° to the initial neutron beam. The angular distribution of the lower energy protons appeared to be isotropic over the observed range, while the higher energy protons and the deuterons showed a preference for emission in the forward direction. A distinct deuteron group of 70 MeV energy was observed. The total nuclear cross-section of the C for the production of all the observed particles was estimated to be 24 ± 12 barns. L. R. S.

539.172.4

5654. Capture cross sections for fast neutrons. HUGHES, D. J., SPATZ, W. D. B. AND GOLDSTEIN, N. *Phys. Rev.*, **75**, 1781–7 (*June* 15, 1949).—The neutron capture cross-sections at an effective energy of 1 MeV have been measured for 32 isotopes, including 4 isomeric pairs. Unmoderated fission neutrons were used as the source, and the high intensities available by this method have made it possible to measure fast cross-sections as low as 10^{-4} barn. The cross-sections (except those for a few "magic number" nuclei) show a smooth variation with atomic weight, ranging from 10^{-1} b at $A=100$ to 10^{-4} b at $A=20$. The rapid change in cross-section is a measure of the change in level spacing of the compound nucleus formed after neutron capture. A survey is made of all the existing data on absorption cross-sections as functions of A and neutron energy. A.

539.172.4

5655. Critical radius of a nearly spherical body in an infinite container. DAVISON, B. *Nat. Res. Coun.*

Can. Publ. (*No.* 1820) 1–64 (*July* 25, 1949).—An expression for the change in the critical volume of a sphere of multiplying material, which suffers a given small deviation from the spherical shape is derived on the basis of the transport equation for neutrons of a constant velocity. The multiplying material is assumed to be surrounded by an infinite medium of the same total mean free path and the cross-section for multiplication in the sphere is treated as a negative capture cross-section. Purely mathematical. L. R. S.

539.172.4 : 539.166

5656. The resonance capture of slow neutrons and emission of gamma-rays. III. Resonance groups of silver. NONAKA, I. *Proc. Phys.-Math. Soc. Japan*, **24,** 33–40 (1942) *In English.*—The energy of the γ-ray-producing slow neutrons was compared with that of the radioactivity producing neutrons. It is reported that there was no evidence that both neutrons differ in their energies, contrary to the result of Burhop, Hill and Townsend [Abstr. 1583 (1938)].

S. C. A. P.

539.172.4 : 539.166

5657. Excitation of γ-rays by fast neutrons of different energy. NONAKA, I. *Proc. Phys.-Math. Soc. Japan*, **23,** 925–38 (1941) *In English.*—Atomic cross-section of Al, Si, Fe, Co, Cu, Ag, Cd and Pb for γ-ray excitation by fast neutrons of different energies from 2·25 to 2·90 MeV were determined. In most cases anomalies were observed in the cross-section energy curves. The absolute magnitude of the cross-section of Cu at $\phi = 90°$ ($E = 2{\cdot}52$ MeV) was estimated to be 2×10^{-24} cm². S. C. A. P.

539.173.4

5658. The probability of disintegration of deuteron by neutron. ISHIZU, T. *J. Phys.-Math. Soc. Japan*, **16,** 292 (1942).—The reaction $n^1 + H^2 \rightarrow n^1 + n^1 + H^1$ was considered as a transition of a deuteron in reaction with a neutron from its ground state to the continuous energy level. The collision cross-section was calculated for incident energy of 30 MeV and 17 MeV as $3{\cdot}2\times10^{-25}$ cm² and $2{\cdot}1\times10^{-24}$ cm² respectively. Angular distribution was calculated and discussed.

S. C. A. P.

539.173.4

5659. Disintegration of deuterons by neutrons. ISIDU, T. *Proc. Phys.-Math. Soc. Japan*, **24,** 828–42 (*Oct.*, 1942) *In English.*—The cross-sections for the process were calculated with the Born approximation. The interaction potential between nuclear particles was assumed to be a linear combination of 4 different exchange potentials, whose spatial dependencies are identical and expressed by a Gauss's error function. The disintegration is considered as transitions of the deuteron from its ground state to the continuous levels, caused by the interaction with the incident neutron. Total cross-sections calculated for incident neutron energies of 30 MeV and 17 MeV are 3×10^{-25} cm and 2×10^{-24} cm respectively. S. C. A. P.

ATOM AND MOLECULE BEAMS : MESONS NEUTRONS 539.18

539.18

5660. The meson. CLAY, J. *Ned. T. Natuurkde.*, **15,** 2–12 (*Jan.*, 1949) *In Dutch.*

539.1

5661. Life time of neutral vector mesons. NAKAMURA, S. *J. Phys.-Math. Soc. Japan*, **16,** 201–(1942).—The theory of natural disintegration o neutral mesons has been developed by Sakata an Tanikawa [*Phys. Rev.*, **57,** 548 (1940)], whose resu on the life-time of neutral mesons described by vecto field is 10^{-16} sec. Here the calculations are mad to higher approximations, the result being 10^{-} $\sim 10^{-14}$ sec according to the conditions. S. C. A. P

539.1

5662. Relation between mesons and Yukawa' particles. SAKATA, S. AND INOUE, K. *J. Phys.-Mat Soc. Japan*, **16,** 232–5 (1942).—In order to remov difficulties in Yukawa's theory of mesons, a funda mental consideration has been applied to nuclea particles, starting from the standpoint that th mesons and Yukawa's particles have close relation but are of different kind. S. C. A. P.

539.1

5663. Natural disintegration of pseudo-scalar mesons SAKATA, S. AND HIRANO, M. *J. Phys.-Math. Soc Japan*, **17,** 357–8 (1943).—The proper life-time o mesons has been calculated by the pseudo-scala meson theory using Fermi's theory of β-disintegra tion. S. C. A. P.

539.1

5664. Remarks on the present situation in the theor of mesons. MØLLER, C. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 141–7.—A survey of the status of meson theory a the end of 1948. The experimental data are com patible with the assumption that the π-mesons are th quanta of the Yukawa field, thus being intimatel connected with the nuclear forces. The $\pi \rightarrow \mu$ decay seems to be accompanied by emission of a neutrino The decay of the μ-meson is probably a decay of th μ-meson into an electron and two neutrinos, and thi process shows a close analogy to the β-decay o nucleons. Arguments are given for regarding th μ-meson as a kind of electron in a higher mass state and the idea of mass states of elementary particles i general is discussed. A

539.1

5665. Disintegration and nuclear absorption o mesons. ROSSI, B. "*Cosmic Radiation*," *London Butterworth's Scientific Publications Ltd.*; *New York Interscience Publications Inc.*, (1949) 45–55.—After a short historical introduction the paper deals with (*a*) products of the spontaneous decay of μ-mesons (*b*) behaviour of negative μ-mesons; (*c*) effects of th nuclear absorption of negative μ-mesons. Discussion of the experimental data bearing on the first topi leads to these conclusions: (1) the disintegration of a μ-meson always gives rise to a single electron (2) high energy photons are not among the dis integration products of μ-mesons; (3) the energy distribution of decay electrons is not yet known sufficiently well to decide between the differen disintegration schemes that have been suggested, bu it is contrary to the assumption that each meso disintegrates into an electron and a neutrino. Dis cussion of the experimental data bearing on the secon

bject leads to the conclusion that the different haviours of positive and negative μ-mesons at rest due to nuclear absorption of negative mesons. The ost recent results on the mean lives of negative mesons in different elements are presented. With gard to the third point, experimental data show at the nuclear absorption of negative μ-mesons is ten accompanied by the emission of neutrons. No ear evidence for the emission of protons exists, hereas high energy photons are known to be absent. he above results suggest that when a negative -meson undergoes nuclear capture only a small action of its rest energy is used to excite the nucleus. A.

539.18

5666. Mass spectrograph of μ-mesons. ZAWADZKI, . "*Cosmic Radiation*," *London, Butterworth's cientific Publications Ltd.*; *New York, Interscience ublications Inc.*, (1949) 155–6.—The Institute of hysics at the University of Lódź has constructed a eson mass spectrograph. Trajectories of mesons e being determined by means of 4 pairs of crossed orizontal layers of G–M counters. Deviation of the ajectories takes place in both electrostatic and agnetic fields. The total deviation angle for a eson of approx. mass 200 m_e and momentum 0^8 eV/c is $\sim 6°$. Experimental errors are $< 1\%$. he apparatus is operated in a vacuum. The counters f the second pair of layers have walls 30 μ thick so s to minimize scattering. The anticipated number f registrations amounts to 12 daily. A.

539.18

5667. On the measurement of the masses of light harged particles using magnetic deflection. FRANZI-ETTI, C. "*Cosmic Radiation*," *London, Butter-orth's Scientific Publications Ltd.*; *New York, nterscience Publications Inc.*, (1949) 159–64.—The ethod suggested by Powell and Rosenblum for easurement of the masses of light charged particles described. According to this method, the deflection f the particles by a strong magnetic field is detected y a suitable arrangement of photographic plates. Details are given of an experimental device already ut into operation. A.

539.18

5668. Mass measurements on mesons at 1 000 etres. PEYROU, C., LHÉRITIER, M. AND LAGARRIGUE, . "*Cosmic Radiation*," *London, Butterworth's cientific Publications Ltd.*; *New York, Interscience ublications Inc.*, (1949) 181–3.

539.18

5669. On the problem of the spin of the π-meson. *N*ENTZEL, G. *Helv. Phys. Acta*, **2** (*No.* 2) 102–4 1949) *In German.*—Experiments on scattering nisotropy are suggested as a means of establishing he existence of the spin. G. J. K.

539.18

5670. Radioactivity of the meson. DE BOER, J. *Ned. T. Natuurkde.*, **15**, 33–5 (*Feb.*, 1949) *In Dutch.*—A discussion of theoretical considerations on meson ecay [Abstr. 3100 (1948)] and observed energy alues of resultant electrons leads to the conclusion hat interaction between electrons and nucleons is of he same kind as between electrons and mesons and that the product of the Fermi function into ½ life is of the same order for all radioactive processes. J. A. W.

539.18

5671. A method for the calculation of the ratio of the masses of the π and μ-mesons. LOVERA, G. *Nuovo Cim.*, **6**, 229–30 (*May*, 1949) *In Italian.*—The method is based on a linear relation between the grain spacing along the track on a photographic plate and the energy/mass ratio of the particle. Using the data of Lattes *et al.* [Abstr. 3946 (1948)] the method gives $m_\pi/m_\mu = 1{\cdot}58 \pm 0{\cdot}03$, while the usual procedure gives, for the same set of experimental data, $m_\pi/m_\mu = 1{\cdot}65 \pm 0{\cdot}11$. L. P.

539.18

5672. The loss of energy of slow negative mesons in matter. ROSENBERG, R. L. *Phil. Mag.*, **40**, 759–69 (*July*, 1949).—The rate of loss of energy due to ionization is calculated, using the method of Mott [Abstr. 2788 (1931)]. The total cross-section is graphed as a function of v and the rate of loss of energy is graphed as a function of $1/v$, where v is the velocity. The time taken for a meson to come to rest is estimated. L. S. G.

539.18 : 530.145

5673. Phenomenological description of nuclear forces and meson properties. ROSENFELD, L. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York Interscience Publications Inc.*, (1949) 135–40.—The concept of nuclear potential underlying the phenomenological description of nuclear interactions is discussed in the light of recent experimental evidence, especially in relation to the spins, masses and charges of the mesons supposed to be associated with the nuclear field. A.

539.18 : 530.145

5674. On the interaction between mesons. TZU, H. Y. *Phil. Mag.*, **40**, 717–32 (*July*, 1949).—The general features of the interaction between mesons which is transmitted by nucleons in the negative energy states are studied. The subtraction method of Dirac [Abstr. 2179 (1934)] and Heisenberg [Abstr. 4333 (1934)] is used to find the coefficient of the interaction term depending on (field strength),[4] which is the term mainly responsible for the meson-meson scattering. The interaction range $\simeq$ the Compton wavelength of the meson and the singularity at small distances is of the type, R^{-5}. It is doubtful whether such a high order singularity has any physical meaning. The total cross-section for the scattering of mesons by mesons $\simeq 10^{-29}$ cm², and the existence of a closed stationary or quasi-stationary assembly of mesons is unlikely. L. S. G.

539.18 : 530.145

Meson masses and the principle of reciprocity. *See Abstr.* 5256

539.18 : 530.145 : 537.591.1

Cosmic ray mesons and meson theory. *See Abstr.* 5517

539.18 : 530.162

5675. Some considerations regarding the masses of mesons. FÜRTH, R. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 149–51.—In former publications the author had, on the basis of

his principle of "elementary indeterminacy," developed a theory for the explanation of the mass ratio of proton to electron. In the present paper the same principle is applied to the problem of the masses of the mesons. It is found that the masses of the proton and the π-meson should be in the ratio 2π, and that the ratio of the masses of the π- and μ-mesons should be equal to $1 + 1/\pi$. This seems to be in agreement with experiment. The possibility of a whole spectrum of mesons of different masses is discussed. A.

539.18 : 537.591.1

5676. On the nature of cosmic ray mesons recorded on the photographic plate. OCCHIALINI, G. P. S. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.*, (1949) 189–91.—From the observations on the creation and decay of mesons in the emulsion, one can suppose that in the upper atmosphere π^+ and π^- mesons are produced with high energy in nuclear interactions and their decay in flight gives rise to a stream of fast μ^+ and μ^- mesons forming the bulk of the penetrating component of the cosmic radiation. A.

539.18 : 537.591.1

Low energy end of the differential meson spectrum. *See Abstr.* 5515

539.18 : 537.591.8

Concerning new elementary particles in cosmic rays. *See Abstr.* 5551

539.18 : 539.165.2

5677. Energy spectrum of secondary electrons from μ-meson decay. MICHEL, L. Letter in *Nature, Lond.*, **163**, 959–60 (*June* 18, 1949).—The theoretical energy-spectra of the decay electrons resulting from μ-mesons are given. It is assumed that the μ-meson has spin $\frac{1}{2}$, and decays into an electron and two neutrinos. The calculation is repeated assuming one of the neutrinos is replaced by a neutral particle of non-vanishing rest mass. Dirac's hole theory is used to describe the charged particles, and two alternative treatments are given for the neutral particles. E. P. G.

539.185

5678. Magnetic scattering of neutrons by protons. YAMASITA, Z. *J. Phys.-Math. Soc. Japan*, **17**, 354–5 (1943).—The cross-section of the magnetic scattering of neutrons by protons has been calculated non-relativistically, considering the magnetic interaction as the perturbation by use of Dirac's method. The main contributions to the cross-section, when the energy is of the order of 1 MeV, consist of two terms; the one comes from the spin-spin type interaction, and the other from the spin-orbit type interaction. The values of the first term are $1{\cdot}6\times10^{-28}$, $0{\cdot}4\times10^{-28}$, $0{\cdot}25\times10^{-28}$ cm^2, when $E_0 = 1$ MeV, 2 MeV, 4 MeV, respectively, the second term does not change very much with the energy, but diverges when the scattering angle approaches O. S. C. A. P.

539.185

5679. Neutron distributions in elementary diffusion theory. II. WALLACE, P. R. *Nucleonics*, **4**, 48–67 (*March*, 1949).—See Abstr. 3473 (1949). Further results are presented in the same form as in the first paper. The cases treated here are: (*a*) point sourc and concentric spherical shell; (*b*) infinite pile c rectangular cross-section; (*c*) finite pile (rectangula parallelepiped); (*d*) cylindrical pile. A. P.

539.18

5680. The comparison of weak neutron fluxes b using ethyl iodide. SHAW, P. F. D. AND COLLIE, C. H *J. Chem. Soc.*, 1217–21 (*May*, 1949).—A quantitativ study of the factors influencing the reproducibility c extractions of radioactive I from neutron-irradiate ethyl iodide has been made with a view to furnish sensitive method of comparing weak neutron fluxe Exchange rates between the radioactive species pr duced and the inactive ethyl iodide have bee measured, and their bearing on the reproducibility discussed. This method being used, the statistic error of the counts obtained from a weak neutro source was reduced from 14% for dysprosium oxid and indium detectors to 1%. A

539.18

5681. Neutron diffraction by gases. ALCOCK, N. Z. AND HURST, D. G. Letter in *Phys. Rev.*, **75**, 1609–1 (*May* 15, 1949).—Describes the scattering of 0·07 e neutrons by O_2 and CO_2, using the Chalk Rive neutron spectrometer. The scattering is in goo agreement with calculations made semi-classically i which the molecule is replaced by a rigid system c point scatterers. No attempt is made to do th calculation on the quantum-mechanical mode For CO_2 the observed intensity < that calculated a small angles. This may arise from inter-molecula interference. J. T

539.18

5682. Relativistic treatment of neutron-proton elasti scattering in the Born approximation. ALZOFO F. E. Letter in *Phys. Rev.*, **75**, 1773–4 (*June* 1, 1949 —An expression for this is given for pseudoscala mesons with pseudoscalar coupling, together wit the corresponding interaction potential and the no relativistic limit. The non-relativistic values of th cross-section are slightly > the relativistic value for the energy chosen (90 MeV) but the angula distribution is the same. G. J. K

539.18

5683. Total reflection of neutrons on cobal HAMERMESH, M. Letter in *Phys. Rev.*, **75**, 176 (*June* 1, 1949).—It is pointed out that, by reflectin neutrons from a Co mirror magnetized along th beam direction, one can obtain an analogue of Nicol prism. The refractive indices for the two spi states lie on the opposite sides of unity for all wave lengths, and only one of the spin components i capable of undergoing total reflection. The mirro therefore reflects a completely polarized beam. J. T

539.18

5684. Angular distribution of 14-Mev neutron scattered by protons. BARSCHALL, H. H. AN TASCHEK, R. F. *Phys. Rev.*, **75**, 1819–22 (*June* 1 1949).—By bombarding a tritium target with 200 ke deuterons, 14 MeV neutrons were produced. Proto recoils originating in a thin polythene radiator coul pass through 3 proportional counters between whic coincidences were observed. By rotating the foil an the counter about the centre of the foil the angula

stribution of the recoiling protons could be measured. otons corresponding to neutrons scattered through °, 120°, 150°, and 180° in the CM system were bserved. Within the statistical accuracy of about % at each angle the angular distribution of the attered neutrons appeared isotropic. A.

539.185 : 537.533.8

685. High-energy electron accelerators as pulsed eutron sources. COCKCROFT, J. D., DUCKWORTH, C. AND MERRISON, A. W. Letter in *Nature, Lond.*, 63, 869 (*June* 4, 1949).—Using a linear accelerator ith 2 μsec pulses (100 mA peak current) of 3·2 MeV lectrons, peak neutron yields of $\sim 2 \times 10^{12}$/sec were btained from targets of D_2O or Be, the yields being etermined by comparison with a Ra–Be source in In bath expts. It is inferred from these results that, sing a 100 MeV accelerator, time-of-flight measurements could be done with good resolution up to ~ 20 keV neutron energy, and perhaps much higher. A. P. F.

539.185 : 539.164

686. The elastic collision of neutrons and α-articles. NOGAMI, M. *Proc. Phys.-Math. Soc. apan*, **24**, 26–32 (1942) *In English.*—Elastic collision f neutrons and α-particles was treated by assuming at the target α-particles can stay permanently in eir ground states during the collision. The motion f the neutron relative to the c.g. of the α-particle s described by an integro-differential wave-equation, hich can be integrated by the procedure of Flugge *Z. Phys.*, **108**, 545 (1938)]. Numerical computations ere made for the *S*-scattering for several values of ne incident neutron energy, and the results were ompared with experimental data. S. C. A. P.

539.185 : 539.172

687. Energies of neutrons from MsTh-D, La-D, -Be, and Sb-Be photo-neutron sources. HANSON, . O. *Phys. Rev.*, **75**, 1794–9 (*June* 15, 1949).—The nergies of neutrons from several sources have been ompared with those of neutrons of calculable nergies from the Li(p,n) reaction by observing the aximum pulse heights of proton recoils in a H-lled proportional counter. The values found for he average neutron energy from the various sources re: MsTh–D, 197 ± 10 keV; MsTh–Be, 827 ± 30 keV; –Be, 158 ± 5 keV: La–D, 151 ± 8 keV; and Sb–Be, 4 ± 3 keV. These values are consistently lower than hose expected from the measured γ-ray energies and he usually accepted photo-neutron thresholds. etter agreement could be obtained if the photo-eutron thresholds of D and Be were taken as 2·23 nd 1·68 MeV. The energies of the effective γ-rays rom Y^{88} and La^{140} are obtained from the neutron nergies and are found to be 1·86 MeV and 2·53 MeV, espectively. A.

539.185 : 614.8

The fast neutron hazard. *See Abstr.* 5834

539.185 : 669

Effect of neutron bombardment on order in the lloy Cu_3Au. *See Abstr.* 5843

539.185 : 771.531 : 614.898

5688. Slow neutron monitoring with boron- and ithium-loaded nuclear emulsions. TITTERTON, E. W. Letter in *Nature, Lond.*, **163**, 990–1 (*June* 25, 1949).—B- and Li-loaded Ilford nuclear emulsions are used for the detection of slow neutrons in radiation hazard control. The reactions used are $N^{14}(n,\alpha)H^3$ and $B^{10}(n,\alpha)Li^7$. An exposure of 1·86 neutrons/cm² (corresponding to 0·26 of a fortnightly tolerance dose) yields track densities of 86 for B and 7·25 for Li per 10^{-4}cm². These yields agree well with the track densities obtained by calculation. An accuracy of 5% can be expected without undue elaboration of measurement and calibration. R. H. H.

STRUCTURE OF SOLIDS 539.2

539.217.1

5689. Pore structure in activated charcoal. I. Determination of micro pore size distribution. JUHOLA, A. J. AND WIIG, E. O. *J. Amer. Chem. Soc.*, **71**, 2069–77 (*June*, 1949).

539.217.1

5690. Pore structure in activated charcoal. II. Determination of macro pore size distribution. JUHOLA, A. J. AND WIIG, E. O. *J. Amer. Chem. Soc.*, **71**, 2078–85 (*June*, 1949).

539.231 : 537.533.73

5691. Structure of molecular films of stearic acid on copper. SPINK, J. A. Letter in *Nature, Lond.*, **163**, 441 (*March* 19, 1949).—Layers of stearic acid deposited by the Langmuir–Blodgett process on a Cu surface give a grease pattern in the electron diffraction camera at 20°C. This pattern fades on raising the temp., and at 80–85°C continuous rings appear due to Cu stearate. At higher temps. the stearate collects into discrete crystallites showing preferred orientation. The pattern disappears at 130°C when the crystals melt. The crystallites are formed at lower temps. if the multi-layers are allowed to age for some days. M. R. H.

539.232 : 621.385.032.216

5692. Free barium in and evaporated from oxide cathodes. JENKINS, R. O. AND NEWTON, R. H. C. Letter in *Nature, Lond.*, **163**, 572 (*April* 9, 1949).—The free Ba was estimated by treating the desired electrode, isolated by releasing it into a side tube, with H_2O vapour. The amount of Ba evaporated depends on the core material, being highest for "0" nickel (Ni with reducing agents) and lowest for Pt. For "0" Ni, 3·4 ± 0·03 μg of Ba evaporated from 0·8 cm² of oxide in a period of 1 hr at 950°C. The amount of free Ba in the coating on "0" Ni was 0·4 ± 0·07 μg or $3 \cdot 10^{17}$ atoms/cm³. A. H. W. B.

539.26

5693. X-ray diffraction studies of the stretching and relaxing of polyethylene. BROWN, A. *J. Appl. Phys.*, **20**, 552–8 (*June*, 1949).—The orientation of the crystallites when polyethylene is stretched at 96°C is normal in that, from the onset of stretching, the preferred orientation is that wherein the long chain axis is parallel to the direction of stretch. At low extensions the preference for this orientation is weak, but it progressively becomes stronger as stretching proceeds. When polyethylene is stretched at room

temp., the crystallite behaviour is more complicated. The first 20% extension produces no preferred orientation of the crystallites. From 30% to 200% extension the preferred orientation is that wherein the 011 "axis" is parallel to the direction of stretch, and the long chain axis therefore inclined to this direction at an angle of 64°. From 200% extension to the break (about 600% extension), the tilt of the crystallites in the preferred orientation progressively lessens and almost vanishes at the break. The stress-strain diagram of polyethylene is interpreted in the light of these findings. The preferred orientation of the crystallites in the region of the shoulder in necked-down polyethylene is also that wherein the 011 "axis" aligns with the stretching direction. When stretched polyethylene is relaxed by shrinking at elevated temps., the crystallites become disoriented but in a non-random manner. This behaviour is described qualitatively. A.

539.26

5694. An X-ray method for studying rapid phase changes in steels at high temperatures. HEAL, H. T. AND SAVAGE, J. Letter in *Nature, Lond.*, **164,** 105 (*July* 16, 1949).—Indicates the use of a Geiger–Muller counter to record diffracted X-rays from a specimen maintained at high temperature in an evacuated enclosure. Changes taking place in a time of ~ 1 sec may be revealed. A. E. DE B.

539.26 : 539.4.01

5695. Strengths of metals. LIPSON, H. AND STOKES, A. R. Letter in *Nature, Lond.*, **163,** 871 (*June* 4, 1949).—Wood and Rachinger [Abstr. 4177 (1949)] do not give sufficient details of their experimental procedure for others to form an opinion on their claim that line-broadening in cold-worked metals is caused by smallness of crystallite size. The agreement between the observed strength of metals and that calculated from Wood and Rachinger's line breadths and Bragg's equation for the strength of metals does not verify their interpretation; similar agreement is obtained on the inhomogeneous-stress interpretation [Abstr. 1504 (1943)]. A. J. C. W.

539.27

5696. Improved sectioning technique for electron microscopy. BAKER, R. F. AND PEASE, D. C. *J. Appl. Phys.*, **20,** 480 (*May*, 1949).—Improvements in the authors' technique [*Proc. Soc. Exper. Biol. Med.*, **67,** 470–4 (1948)] of preparing very thin sections (to 0·05 μ) are the adjustment of the knife tilt to 0·5° by an optical lever, and the use of dioxane for mounting cut sections, which eliminates direct manipulation. E. E. C.

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.32

5697. Relationship between Gough–Joule coefficients and moduli of vulcanized rubbers. CONANT, F. S., HALL, G. L. AND THURMAN, G. R. *J. Appl. Phys.*, **20,** 526–31 (*June*, 1949).—The Gough-Joule coeffs. (*a*) at constant stress and (*b*) at constant strain are defined and methods of measurement of each o vulcanized rubbers are given. It is shown mathe matically and experimentally that the ratio of (*b*) t (*a*) is equal to the "tangent" modulus. The quotien of the Gough–Joule coeff. at constant stress divide by the stress and the quotient of the Gough–Jou coeff. at constant strain divided by the strain ar shown to be constants which are independent of th stress-strain-temp. conditions of the test. Exper mental data are given for stocks based on Hevea GR–S, Neoprene GN, Butyl Rubber and Butaprene.

539.32 : 541.6

5698. Dynamic measurements of polymer physica properties. BALLOU, J. W. AND SMITH, J. C. *J. Appl Phys.*, **20,** 493–502 (*June*, 1949).—Dynamic metho for measuring the elastic and dissipative properties o high polymers in fibre and film form over 4 decade of frequency (3 to 30 000 c/s) are described. Th experimental quantities resulting from the 3 differen techniques necessary to cover this range are unified b deriving in each case the parameters of an equivalen Voigt Model (elastic and viscous element in paralle which would behave in the same way as the polyme sample. Examples of the application of these tech niques to the characterization of high polymers ar given. The effect of frequency and chemical an physical structure on the derived parameters are dis cussed, along with the question of heat losses resultin from cyclical differential deformation. In addition the application of two of the methods to the charac terization of the stiffness-temp. behaviour of hig polymers is described.

539.32 : 541.6

5699. Creep and damping properties of polystyrene SAUER, J. A., MARIN, J. AND HSIAO, C. C. *J. Appl Phys.*, **20,** 507–17 (*June*, 1949).—The anelast behaviour of polystyrene has been studied by means o creep tests under long-time load application and b means of damping capacity tests under rapidly varyin repeated loading. Tensile creep data taken at variou stress amplitudes reveal that the log of the creep ra (at 1 000 hr) varies linearly with the log of th stress amplitude. A similar type of variation obtained when damping capacity or energy absorbe per cycle is plotted against stress amplitude. Fro these two sets of data, the creep rate is found to b $\propto$ the square of the damping capacity. It would thu appear possible, for polystyrene at least, to predic 1 000 hr creep rates from short-time measuremen of absorbed energy under dynamic loading condition The data obtained from the creep and damping test together with additional data from short-time tensio and compression tests, seem to be consistent with a internal structure in which the linear polymer chair and groups of chains are in ordered or partiall extended positions, but in which, in the absence o stress, no preference is shown for any particula direction. Under the action of stress—particularly the stress is maintained for a long period of time— a tendency exists for the ordered regions to orient i the direction of the applied stress. The so-calle "crazing" condition which has been observed t occur in the creep specimens is probably a manifesta tion of this orientation. X-ray evidence appears t support this point of view.

539.32 : 548.0

Elasticity of zinc crystals. *See Abstr.* 5774

539.37

5700. The third theorem of similarity. KIRPICHEV, M. V. AND KONAKOV, P. K. *Izv. Akad. Nauk, SSSR, Otdel. Tekn. Nauk* (*No.* 1) 50–5 (*Jan.*, 1949) *In Russian.*—This was first stated and proved for elastic phenomena by V. L. Kirpichev in 1874 in the form: solids of the same material which were similar prior to the application to them of external forces, remain so after the application of such forces, if the said forces are distributed in a similar way on the surface of the solids, and the magnitudes of corresponding forces per unit surface area are the same for both solids. The general form of the third theorem of similarity was given by M. V. Kirpichev and A. A. Gukhman [*Leningrad Thermotechnical Inst. Papers No.* 1 (1931)], and its proof by logical analysis of the conditions of similarity of two phenomena by M. V. Kirpichev [*Izv. Akad. Nauk, SSSR*, **1** (1933)]. The present investigation is an analysis based on the principles of continuous transformation groups (Lie groups). Its result may be formulated thus: The complete set of phenomena determined by given differential equations and mono-valency conditions, represents a (continuous) group of similarity transformations, if the quantities entering the mono-valency conditions themselves form a (continuous) group of similarity transformations, and if the invariants of this group, determined by the given differential equation, and composed of the said quantities, have the same numerical value. B. F. K.

539.37

5701. Saint-Venant's and Filon's finite strains: definitions non-linear in displacement gradients. SWAINGER, K. H. Letter in *Nature, Lond.*, **164,** 23–4 (*July* 2, 1949).—A state of finite homogeneous strain is completely defined by the space derivatives of the displacement vector. Components of "true strain" [see Abstr. 3688 (1947)] can be defined, in which terms involving products of the displacement gradients are absent. The case of three superposed pure strains parallel to Cartesian axes is discussed in detail. J. G. O.

539.37

5702. Application of similarity to anelasticity. ZHRING, M. W. Letter in *Nature, Lond.*, **163,** 772–3 (*May* 14, 1949).—A dimensionless parameter is obtained from Zener's equation for a standard linear solid. This parameter is modified to take into account grain-size, thus obtaining a dimensionless form of Kê's parameter [Abstr. 1656 (1947)]. J. E. C.

539.373

5703. Fine structure of slip-zones. BROWN, A. F. Letter in *Nature, Lond.*, **163,** 961–2 (*June* 18, 1949).—Electron-micrographs of slip zones formed in pure Al between liquid air temp. and 500°c showed that the zones can be resolved into elementary slip lines, the slip unit being approximately the same at all temps. The effect of increasing deformation at various temps. on the density and shape of the lines is described. J. A. F.

539.374

5704. The stress-strain laws of the mathematical theory of plasticity—a survey of recent progress. PRAGER, W. *J. Appl. Mech.*, **15,** 226–33 (*Sept.*, 1948).—Phenomenological theories are reviewed for initially isotropic, inviscid and incompressible plastic materials, with special reference to loading, yielding and unloading. The conditions of continuity and uniqueness are stressed and alternative forms of various stress-strain laws are given. Consideration is given to some elastic laws involving both quadratic and cubic invariants of stress. Methods of solution of the equations of plastic flow are indicated. J. E. C.

539.374

5705. A generalised deformation law. DAVIS, E. A. *J. Appl. Mech.*, **15,** 237–40 (*Sept.*, 1948).—The strain distribution variable $\nu' = \gamma_3 - \gamma_1/\gamma_2$ (where γ_1, etc., are the principal shear strains) is assumed to be a function of the stress distribution variable $\mu = \tau_3 - \tau_1/\tau_2$, where τ_1, etc., are the principal shear stresses. In addition, the octahedral shearing strain is assumed to be a different function of the octahedral shearing stress. With the assumption of incompressibility, the principal normal strains are expressed in terms of these two functions. Modifications are discussed for the case of finite strain and for strain composed of elastic and plastic parts. J. E. C.

539.374

5706. Stress-strain relations for finite elastoplastic deformations. DORN, J. E. AND LATTER, A. J. *J. Appl. Mech.*, **15,** 234–6 (*Sept.*, 1948).—A linear stress-strain law is proposed for an isotropic elastoplastic medium in both the elastic and plastic range, with the strain defined logarithmically. J. E. C.

539.374

5707. Plastic deformation of silver chloride. I. Internal stresses and the glide mechanism. NYE, J. F. *Proc. Roy. Soc. A*, **198,** 190–204 (*Aug.* 15, 1949).—The experiments of Obreimow and Schubnikoff [*Z. Phys.*, **41,** 907 (1927)] on the birefringence produced by the plastic deformation of single crystals of rock salt have been extended to a polycrystalline material. Rolled sheets of AgCl have been recrystallized and then deformed plastically in various ways—by simple extension and by bending, for example. The sheets are transparent and very ductile and, since AgCl is cubic in structure, the birefringence patterns observed under the microscope provide a picture of the distribution of the internal stresses uncomplicated by natural double refractions. It is suggested that results obtained with this optical method are applicable to metals. AgCl appears to deform by glide, and when the glide packets are observed on edge a characteristic pattern of parallel birefringent bands is visible. The relation of the glide plane and glide direction to the crystal structure has been studied by making observations upon these bands and upon the glide lines formed on the surfaces of bars of square cross-section consisting effectively of chains of single crystals. The orientations of the 15 sets of glide bands examined in this way were all consistent with glide movements in a ⟨110⟩ direction; the glide plane, however, was not always a crystallographic plane of low indices. In the 6 cases in which the measurement was possible, it lay within 9° of the plane in the ⟨110⟩ zone on which the maximum shear stress, resolved in the ⟨110⟩ direction, acted. It is

concluded that AgCl deforms by "pencil glide," the mechanism postulated by Taylor and Elam [*Proc. Roy. Soc. A*, **112**, 337 (1926)] to explain the plastic behaviour of α-iron. The transmission of pencil glide across grain boundaries is discussed. The residual stresses observed by the optical method in polycrystalline sheets may be divided into 3 groups: (1) A system of stresses set up between the glide zones of each grain and alternating with a period equal to the spacing of the glide zones. (2) Alternating stresses produced when a system of glide zones meets a grain boundary. (3) "Heyn stresses" produced by the non-uniformity of plastic deformation from grain to grain. A.

539.374 : 541.182.5

5708. Measurement of the elasto-plastic properties of gels. GOLDSMITH, K. Letter in *Nature, Lond.*, **163**, 601 (*April* 16, 1949).—The firmness intensity factor is measured for a gel which shows both elastic and plastic deformation under applied stresses by means of a vane embedded in the gel and attached to a torsion head. The equation $ln[\alpha/(\alpha - \delta)] = C(1/E + t^k/\Psi)$ is proposed relating the initial deflection α, the instantaneous deflection δ, the time t and with C, E, Ψ and k constants. J. E. C.

539.374 : 666

5709. Plastic deformation of optical glass. TAYLOR, E. W. Letter in *Nature, Lond.*, **163**, 323 (*Feb.* 26, 1949).—Describes hardness micro-tests on optical glasses employing a pyramidal diamond indenter. Under a light (50 gm) load, borosilicate crown and extra dense flint glasses showed perfect indentations about 10 μ square, heavier loads causing fracture. No difference in behaviour is shown between plane-polished, newly fractured, and fine-finished surfaces, all thus showing real flow in the surface layers. G. O. J.

539.374 : 666.1/.2

5710. Some aspects of the flow properties of glass of very high viscosity. JONES, G. O. *J. Soc. Glass Tech.*, **33**, 65–76 (*Feb.*, 1949).—Experimental data on the flow properties of glass of very high viscosity, that is, at temps. below the transformation region, are reviewed and discussed from the standpoint of modern rheological theory. The form of the function governing the delayed elastic effect and the variation of the total magnitude of this effect with temperature are especially considered. Some of the contradictory statements existing in the literature on these points are discussed. A.

539.382

5711. An apparatus to depict the load-elongation diagram of yarn at five cycles per second. BREAZEALE, F. AND WHISNANT, J. *J. Appl. Phys.*, **20**, 621–6 (*June*, 1949).—An apparatus is described which presents on a c.r.o. the load-elongation hysteresis diagram, loading and unloading, of a length of yarn. A.

539.411.5

5712. Resistance against deformation of metals at velocities from 10^{-6} to 10^2 m/sec. I. VITMAN, F. F., ZLATIN, N. A. AND JOFFE, B. S. *J. Tech. Phys., USSR*, **19**, 300–14 (*March*, 1949) *In Russian.*—A new simple method is presented of investigating the dependence of the resistance of metals to deformation on t velocity of the latter. Experimental results are giv on Pb, Al, Cu, soft steel and duralumin. It was fou that within a wide range of deformation speeds t speed variation cannot be the only parameter which the relation between resistance to deformati and speed of the latter depends. Comparison of t test results with earlier data shows that the meth now adopted has justified itself and permits of extension of the velocity range over another 1·5 to the other side of greater speeds. B. F.

539.411

5713. Resistance against deformation of metals velocities from 10^{-6} to 10^2 m/sec. II. VITMAN, F. AND ZLATIN, N. A. *J. Tech. Phys., USSR*, **19**, 315– (*March*, 1949) *In Russian.*—Results are presented cone indentation tests on Pb and soft steel for i vestigating the dependence of deformation resistan on deformation speed at various temperatures. T test results disclose the existence in the speed variatic range of the tests (10^{-3}–10^5 sec^{-1}) of 3 regio differing from one another in the character of t deformation process. It was also made evident th the McGregor–Fischer equation [*J. Appl. Mec* **12**, *A*217 (1945); **13 A**, 11 (1946)] holds good on below recrystallization temperature at deformatic speeds not excluding the onset of recrystallizatic during the tests; in such conditions only is it possib to expect an appreciable influence of the stress—c deformation (including solidification)—on the activ tion energy of the metal, on which this equation based. B. F. I

539.431 : 534.3

5714. Variation of the damping at cyclic stressin below and above the fatigue limit. (Contribution t the problem of the physical nature of the fatigu process.) GLIKMAN, L. A., ZHURAVLEV, V. A. AN SNEZHKOVA, T. N. *J. Tech. Phys., USSR*, **19**, 448–6 (*April*, 1949) *In Russian.*—The specimens were teste on a specially designed fatigue testing machine fo alternating stressing and the decrement of dampin of the specimens was measured at various stages c the cycle. For 3 steels (2 carbon and 1 high-chrom stainless) the variation of the damping was studie in cycles of varied amplitude, above and belo the fatigue limit, this including the investigation c the influence of intermediate ageing and temperin in the cyclic treatment on the variation of the damping The results of the investigation are a further contribu tion to the explanation of the physical character c the ageing process. B. F. K

539.50

5715. Some properties of a mechanical model o plasticity. BOHNENBLUST, H. F. AND DUWEZ, P *J. Appl. Mech.*, **15**, 222–5 (*Sept.*, 1948).—A mode proposed earlier [Abstr. 1944 (1935)] consisting of statistical distribution of individual elements whos properties are specified, is used to derive the potentia energy of a metal when cold-worked. J. E. C

539.53 : 620.178.15 : 621.317.3

5716. The determination of the hardness of organi films. HOEKSTRA, J. AND NIJVELD, H. A. W. *Rec Trav. Chim. Pays-Bas*, **67**, 685–9 (*Nov.*, 1948) *I*

glish.—A special apparatus is described for easuring, with an accuracy of $\pm 0{\cdot}1\ \mu$, the depth penetration under load of a diamond point into a in organic film, e.g. paint films. The diamond int is attached to a plate of a condenser and a ferential effect is obtained by having fixed plates on th sides of the moving plate. This condenser forms o arms of a bridge and the measurement is per-rmed during the application of the force. The sults can be given in the form of "Vickers Hardness" ures. Results quoted for a lacquer show how the rdness varies with the thickness and, for a given ickness, with time. The instrument as described vers a range of Vickers Hardness of 0·5–100 kg/cm², nilst most lacquer films have a value of $\sim$ 10 kg/cm². J. I.

539.539

17. Yield value of bentonite suspensions. BALLAN-NE, E. R. Letter in *Nature, Lond.*, **163**, 995–6 *une* 25, 1949).—Yield values were determined from photographic trace relating the force required to ove a thin plate in its own plane to the time. They pended markedly on the material of the plate for prox. 5% Wyoming and Queensland bentonite at pH $\simeq$ 8·4. From the data quoted various possible planations are eliminated. J. E. C.

539.61

18. A method for studying the forces between etals and ionic substances. MARBOE, E. C. AND EYL, W. A. *J. Appl. Phys.*, **20**, 124 (*Jan.*, 1949).—he method depends on the fact that atomic Au lsorbed on a white solid has no visible light absorp-n while metallic Au in large crystals has a clearly fined colour. Atomic Au is not stable at room mps. and tends to diffuse and aggregate at a rate rying inversely with the strength of the surface rces, which can thus be estimated by observing the te of diffusion. G. O. B.

539.62

5719. Solid solubility effect of metallic surface friction. UMEDA, K. AND NAKANO, Y. Letter in *Phys. Rev.*, **75**, 1621 (*May* 15, 1949).—The friction-coefficient/temperature curve for a number of metal pairs follows closely the solubility/temperature curve on the side of the lower melting-point metal and supports the "local melting" theory of friction. μ vanishes suddenly at the eutectic point of the system. A. E. DE B.

539.62 : 534.372

5720. Measurement of the internal friction of solids. KAMEL, R. Letter in *Phys. Rev.*, **75**, 1606 (*May* 15, 1949).—The internal friction, measured by the damping of transverse vibrations in vacuum, of tin, brass, lead and glass when plotted against frequency each show one maximum below 1 000 c/s. The positions of these, and of one of the two peaks for steel, agree with Zener's theory [Abstr. 619 (1940)] attributing friction to thermal currents. D. H. W.

539.893 : 532.12

5721. Further rough compressions to 40 000 kg/cm², especially certain liquids. BRIDGMAN, P. W. *Proc. Amer. Acad. Arts Sci.*, **77**, 129–45 (*Feb.*, 1949).—Using a technique developed earlier [Abstr. 2414 (1942)] with the modification that the Pb capsule is sealed by amalgamating the sealing point with Hg and leaving under light pressure for 18 hours, the compressions of 30 hydrocarbons were determined for pressures up to 40 000 kg/cm². A supplementary apparatus was used for the range 0–5 000 kg/cm². Most of the liquids pass through their freezing points, but the volume differences are at 25°C and the pressure indicated, not for the correct equilibrium pressure at 25°C. The results are compared with previous values. They include values for dimethyl siloxane from the dimer to octamer and nine other Dow Corning fluids. J. E. C.

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.124/.128

541.126

22. Explosions in liquids initiated from the gas hase. GRAY, P. AND YOFFE, A. D. Letter in *esearch, Lond.*, **2**, 339–40 (*July*, 1949).—Vapours of ethyl nitrate, ethyl nitrate and nitroglycerine, luted from 10^3 to 10^6 times with A and N, are und to glow on admission to a hot quartz vessel. his luminosity is observed for temperatures between 00°C and 500°C and total pressures < a few cm Hg. he fact that ignition of these explosive vapours can cur at such low concentrations supports the view at vapour-phase inflammation in small entrapped bbles plays an important part in the initiation of quid explosives by impact [See Abstr. 2224 (1948)]. A. SCH.

ELECTROCHEMISTRY 541.13

541.132

23. Ionic hydration. MOELWYN-HUGHES, E. A. *oc. Camb. Phil. Soc.*, **45** (*Pt* 3) 477–81 (1949).—Intermolecular force theory applied to ionic hydration is briefly discussed, and it is shown that with reasonable assumptions the absolute calculation of ionic dimensions in aqueous solution is possible without reference to the condensed states of matter. The method consists in the *a priori* calculation of the average internuclear distances between ion and solvent molecule, and the computation of the potential energy U_0 of the ion and its solvent neighbours at equilibrium in terms of the corresponding internuclear distance, α_0. The observed heats of hydration for alkali metal cations are in good agreement with the calculated values of U_0. Using the experimental heats of hydration to calculate α_0 for halogen anions shows that the α_0 values are on the average 0·18 Å greater than those for the corresponding cations. For several divalent cations the calculated α_0 values exceed the "crystal" radii by about 1·05 Å. J. O'M. B.

541.133 : 541.182

5724. Determination of the critical concentration of micelle formation of sodium oleate by means of the Wien effect. EXNER, M.-L. *Naturwiss*, 35

(*No.* 11) 344 (1948) *In German.*—A graph of % increase of conductivity at high field strengths against concentration shows a sharp rise from 4 to 10% at 1·5 g equiv./l, and this is taken as the critical concentration of micelle formation. D. H. W.

541.135

5725. Hydrogen overvoltage. FRUMKIN, A. *Disc. Faraday Soc.* (*No.* 1) 57–67, *disc.* 127–40 (1947).—Recent work carried out by the author and co-workers on H overpotential is summarized. It is shown that for metals with high overpotentials (e.g. Hg) the slow stage is the discharge of H ions on to a metal surface free from adsorbed H. For Hg in solutions of concentration $< 0{\cdot}3\ N$ an equation $\eta = 1{\cdot}46 + 2RT/F \log i + \Psi_1 - RT/F \log (H^+)$ is derived theoretically and shown to agree with experiment. On metals of low overpotential it is shown that a comparison of the rates of different stages of H evolution is possible by use of an a.c. method and the rate of discharge of H ions can be determined experimentally. On such metals the stages subsequent to the discharge affect the kinetics of the overall reaction rate. H evolution is studied experimentally in relation to the H ion discharge rate. The presence of oxide films has a marked effect on H overpotential and may give rise variously to time variation, anomalous values of the coefficient b of Tafel's equation and an increase in overpotential. When dissolution of the metals occurs at the same time as the deposition of H the rate of the latter measured by reference to H evolution is still given by Tafel's equation with ordinary values of the coefficients. Conclusions on dissolution of metals can be drawn.

J. O'M. B.

541.135

5726. The theory of overvoltage. AUDUBERT, R. *Disc. Faraday Soc.* (*No.* 1) 72–80, *disc.* 127–40 (1947).—An equation is derived relating c.d. to the rate of discharge and ionization of ions at the electrode surface involving the activation energies of the two processes and the fraction of the electrode potential operating on each. The ionization term may be neglected for Cu, Hg, Au, Ag, etc., but must be taken into account in the cases of Na, K, Mg, Al, Zn, etc. The theory is examined over a wide range of potentials and confirmation is claimed. Using data at different temps. the theory is employed to calculate the values of the activation energies of the various processes and a great complexity of the mechanism of overall discharge is indicated. Potential energy curves are constructed for the ion in solution and at the electrode and their significance is discussed and related to the mechanism of the processes occurring at the electrode. The effect of active centres in the metal surface on the discharge and ionization reactions is discussed in relation to the energy of interaction of the unsolvated ion with the electrode metal. It is claimed that this supplies an explanation of the cases in which the elementary theory breaks down. J. O'M. B.

541.135

5727. The interpretation of overpotential measurements. AGAR, J. N. *Disc. Faraday Soc.* (*No.* 1) 81–6, *disc.* 127–40 (1947).—The lack of attention paid to variables other than current and potential in work on activation overpotential is criticized. The influences of temp., concentration of reactants and presence of neutral salts are discussed in relation possible applications to experimental data. T heats of activation may be measured by two differ methods and these differ in a typical case by ab 1·7 k.cal. The relations between the heat of acti tion and cathode potential and between "α" in equation $b = 2{\cdot}303RT/\alpha F$ are discussed and th application to the determination of react mechanisms is briefly considered. The applicat of the evidence from the study of the influence concentration, of reactants and presence of neu salts on the double layer as a test between vari mechanisms is discussed. J. O'M.

541.

5728. Overpotential at very low current densit The deposition of hydrogen from aqueous and n aqueous electrolytes. An experimental determinat of the capacity of the double-layer. BOWDEN, F. AND GREW, K. E. W. *Disc. Faraday Soc.* (*No.* 86–90, 91–4 (1947).—The overpotential at a cathode was measured in $N/5H_2SO_4/H_2O$; HCl/MeO ($0{\cdot}35\ N$ and $0{\cdot}14\ N$) and $0{\cdot}4\ N$ HCl/Pyrid and the values of the cathode potential obtai in formic acid at a c.d. $< 10^{-6}$ amp/cm². Spec precautions were taken against the ingress of into the system, the measurements being carr out through the walls of the electrolytic cell wh was sealed off completely from the atmosphe For the deposition of H ions from aqueous so tion the equation $v = b(\log i - \log i_0)$ holds do to a c.d. of 10^{-9} amp/cm²; $b = 0{\cdot}138$ and $\alpha = 0$ $(= 2{\cdot}303RT/bF)$. With methanolic solutions same relation held down to a similar c.d. value, a hysteresis effect was observed between 10^{-6} a 10^{-7} amp/cm²; $b = 0{\cdot}14 \rightarrow 0{\cdot}1$. In pyridine linear relation held only from 10^{-9}–10^{-6} amp/c ($b = 0{\cdot}05$). After prolonged polarization, unc trollable fluctuations occurred. In formic acid satisfactory value could be obtained for the reversi potential but the cathode potential varied linearly w c.d. from 10^{-8} to 10^{-6} amp/cm² ($b = 0{\cdot}024$). In second paper the experimental technique used (abo is applied to the direct measurement of the capac of the double layer for each of the above systems measuring the rate of charging of the interface. Hg in H_2SO_4 the value of 20 μF/cm² was obtain Agreement with other methods is discussed.

J. O'M.

541.

5729. The electrodeposition of hydrogen on p ladium. STOUT, H. P. *Disc. Faraday Soc.* (*No.* 107–14, *disc.* 127–40 (1947).—Results obtained cathodic and anodic polarization of Pd in $N/5$. H_2S with changing c.d. are given. The variation of slope of the Tafel line with the value of the sta (unpolarized) potential and the relation of the lat to the amount of H present in the metal are al investigated. The unpolarized potential of Pd shown to be determined by an equilibrium betwe H ions in solution and H adsorbed in the electro The higher the concentration of the latter the mo negative is the static potential. The linear V/lo relationship is claimed to be due to a rate-determini process in the formation of gaseous H, for t

creases as the unpolarized potential becomes more gative. The max. amount of H sorbed (0·65 om of H/atom of Pd) by the Pd electrolytically rresponds to the number of vacant states of the 1 available for the electrons of the ionized H ·6 per atom of Pd). J. O'M. B.

541.135

730. Crystal growth at the cathode. FINCH, G. I., ILMAN, H. AND YANG, L. *Disc. Faraday Soc.* (*No.* 1) 4–58, *disc.* 182–9 (1947).—The formation of metallic posits upon metals is discussed and the relation beeen the cathodic process (electrodeposition) and her processes, such as condensation, is briefly reewed. It is seen that the electrodeposition of metals influenced primarily by (1) the rate of arrival of metal ns, (2) the mobility of ions on the cathode surface,) the arrangement of atoms in the substrate,) microscopic variations in the electrode field over e cathode surface, (5) the presence of other lsorbed or codeposited entities, and by the deendence of all these factors on experimental nditions. Results of electron diffraction methods sed in the cases of Ag, Au, Bi, Co, Cd, Cr, Cu, Fe, i, Pt, Pd, Pb, Sn, Sb and Zn are given and show that e cathodic process involves 3 stages, (*a*) an initial age in which the structure of the deposit is "subrate-determined," (*b*) a transition stage, and (*c*) a nal stage (thick deposits only) in which structure is haracteristic of conditions of deposition. These ages are discussed in detail with reference to perimental data. Tables and typical photographs lectron diffraction patterns) are included. J. O'M. B.

541.135

731. Electrolytic polarization. III. The effect of e solvent on the oxygenover potential. BOCKRIS, O'M. *Disc. Faraday Soc.* (*No.* 1) 229–35, *disc.* 48–53 (1947).—The overpotential on smooth Pt was easured at c.d.'s between 10^{-3} and 10^{-1} amp/cm^2 N H_2SO_4 solns. in acetic-acid–H_2O and dioxan–$_2O$ mixtures. Addition of either of the non-aqueous mponents to the solution caused the overpotential increase considerably for the first small additions d then progressively less for each increment. For etic-acid–H_2O the constant value at 100% AcOH is proached asymptotically, while for dioxan–H_2O an pparent max. occurs, the proportion of dioxan in $_2O$ at this max. depends on the current density used. he slopes of the Tafel lines are increased by the esence of either acetic acid or dioxan, being approx. oubled in the case of acetic acid. Time effects are ualitatively independent of the solvent. J. O'M. B.

541.135

732. Oxygen overvoltage. I. The influence of ectrode material, current density and time in aqueous lution. HICKLING, A. AND HILL, S. *Disc. Faraday oc.* (*No.* 1) 236–46, *disc.* 248–53 (1947).—The terrupter method of overpotential measurement is pplied to oxygen overvoltage and the results compare vourably with values obtained by the direct method. d, Co, Cu, Au, C, Fe, Pb, Ni, Pd, Pt, Pt/Pt and Ag e used as anodes in N aqueous KOH solution and producible results are obtained if sufficient time is llowed to elapse before measurements for the overtential equilibrium to be set up. The values of the verpotential found are considerable (generally larger than corresponding hydrogen overpotential) and their dependence on the value of the c.d. has little relation to the Tafel equation. This applies only over limited ranges of c.d. in the cases of Co, Fe, Ni, Pt, Pt/Pt, Pd, Ag and Cu and the value of b in the Tafel equation varies from 0·07 to 0·3 at different electrodes. The formation of deposits on the anodes was observed and was usually related to sudden changes in the overpotential. J. O'M. B.

541.135

5733. The energy of activation in the electrodeposition of oxygen. STOUT, H. P. *Disc. Faraday Soc.* (*No.* 1) 246–7, *disc.* 248–53 (1947).—The energy of activation of deposition of O from an N/10 aqueous NaOH soln. on to Pt was found to be 25·3 k.cal. at the reversible potential. The anode potential was measured against a saturated calomel electrode for a constant current at temps. between 18° and 32°c, the change of both variables with time being plotted. The value of the energy of activation at a constant current i is taken as $H = -\alpha FT(dV/dT)i$. The value obtained is appreciably $>$ the value obtained in $N/5$ H_2SO_4 and this suggests that different rate-determining processes are operative in the two solutions. J. O'M. B.

541.135

5734. Some investigations on the oxygen-overpotential in molten salts. FLOOD, H. AND FØRLAND, T. *Disc. Faraday Soc.* (*No.* 1) 302–7, *disc.* 325–8 (1947).—The overpotentials measured between a Pt sheet polarized anodically and an unpolarized Pt wire in melts of Li–Na sulphate, and sodium phosphate, sulphate carbonate and silicate separately dissolved in a melt of LiF had similar relations to the current density and to temp. effects. Two sections of the log d.c. × overpotential curve are observed: at low c.d. and high temps. the curve probably represents a concentration overpotential, while at low temps. and high c.d.'s an activitation overpotential is supposed to exist. In fluoride melts the activitation overpotential decreases in the order:

$$SO_4^{--} > PO_4^{---} > CO_3^{--} > SiO_4^{----}$$

For melts of Na_2O, Li–Na fluoride and $Na_2CO_3 + K_2CO_3$ similar measurements show that the overpotential has a different character from that in the above system. At low c.d.'s a linear relation between overpotential and c.d. is observed. In these last cases Pt was observed to be present in the solution. J. O'M. B.

541.135

5735. The standard electrode potentials of the elements. BOCKRIS, J. O'M. AND HERRINGSHAW, J. F. *Disc. Faraday Soc.* (*No.* 1) 328–34 (1947).—A summary of the values contained in the literature for electrode pots. corresponding to the equilibria: $M^{z+} + ze \rightleftharpoons M$; $A + ze \rightleftharpoons A^{z-}$ in aqueous solutions. The difficulties which arise in the measurement of standard electrode potentials are summarized. The values given are classified as to their reliability. The standard potentials of the more usually used half cells are also given. 116 references. J. O'M. B.

541.135

5736. Activity coefficients in concentrated solutions containing several electrolytes. GLUECKAUF, E. *Nature, Lond.*, **163**, 414–15 (*March* 12, 1949).—

Guggenheim's empirical equation for the activity coeff. of an electrolyte in the presence of another has been modified so that it may be applied at ionic strengths of up to about 3 mol/l. The modification is made by assuming that the constants λ of the original equation are functions of the ionic strength, and the equations which result contain no freely adjustable constants. The new equations may be made to apply to cases where all the ions are different or where there are > 2 solutes. Agreement between observed and calculated values of the activity coeffs. of HCl in the presence of BaCl is found up to 3 molar ionic strength. Data are given to show that the modified equations enable (*a*) mass-law equations to be applied to the solubilities of highly soluble electrolytes, and (*b*) activity coeffs. of pure solutes in supersaturated solutions to be calculated. J. O'M. B.

541.135.5

5737. Electrochemical periodicities in the anodic polarization of platinum electrodes in the presence of hydrogen and their significance. ARMSTRONG, G. AND BUTLER, J. A. V. *Disc. Faraday Soc.* (*No.* 1) 122–6, *disc.* 127–40 (1947).—Possible processes which may occur in the cathodic liberation of H and practical methods available for investigating the nature of the H entities associated with the electrode are listed. The behaviour of a smooth Pt electrode when polarized anodically at large, intermediate and small current densities in a solution saturated with H is studied and periodicities are observed in the value of the electrode potential (from 0·0 to 0·4 V) at small and intermediate c.d.'s. As the c.d. is increased these periodicities are less well defined. This indicates the presence of two processes by which H ionization can occur at the same Pt surface. J. O'M. B.

541.135.5

5738. Kinetics of electrode processes on the iron electrode. KABANOV, B., BURSTEIN, R. AND FRUMKIN, A. *Disc. Faraday Soc.* (*No.* 1) 259–69, *disc.* 298–301 (1947).—The effect of anodic polarization on an Fe electrode initially completely free from O or initially having an oxide film on it of controlled extent is investigated. It is shown that passivation of the Fe in strong alkali is due to the presence of an incomplete layer of γ-Fe_2O_3 or Fe_3O_4 5·3 Å thick, while in dilute alkali passivation occurs with $<$ a monolayer of O, there being an essential difference between the processes operative in the two solutions. On O-free Fe in strong alkali the anodic polarization curves have two arrests, one corresponding to the formation of $Fe(OH)_2$ and the other to the formation of a passive film. Lowering of the polarization temp. is found to decrease the amount of O required to effect passivation. An explanation is offered as to the mechanism of these processes and the presence of O on the Fe surface has two effects: that of accelerating the dissolution and that of passivating the Fe, curtailing the dissolution. The presence of Cl ions in solution is observed to prevent passivation of the Fe while at sufficiently high concentrations of alkali and high c.d.'s the Fe becomes suddenly passive, but is reactivated by lowering the c.d. The first effect is explained by suggesting that adsorption of Cl retards the deposition of O and the formation of passivating oxides. J. O'M. B.

541.135

5739. The anodic behaviour of metals. IV. Silve HICKLING, A. AND TAYLOR, D. *Disc. Faraday Soc* (*No.* 1) 277–85, *disc.* 298–301 (1947).—The initi build-up of anodic polarization at a plated Ag ano is studied using an oscillographic method whi records the variation of potential with quantity electricity passed prior to O evolution. N. NaO solution and a limited number of buffer solutio are used as electrolytes. Oscillograms are obtain under varying conditions of c.d. and temp. and in t presence of various anions in the alkaline solutio while in the buffer solutions the effect of varying *p* on the oscillograms at a standard temp. and c.d. w observed. The effect of cathodic polarization w studied in some cases. The oxide potential of A and the true area of the Ag electrode were measure The form of the oscillograms in NaOH solution due to 3 stages in the polarization, the charging the double layer, the formation of a film of Ag_2 (the thickness depending on experimental condition and the formation of an oxide which decomposes give Ag_2O_2. With decreasing *p*H down to a *p*H of the anodic polarization remains similar to th observed in the NaOH solution but below th value the Ag does not become passive, the anod process being the dissolution of Ag. J. O'M.

541.135

5740. The potential of ion-exchanging substance TENDELOO, H. J. C. *Disc. Faraday Soc.* (*No.* 293–8, *disc.* 298–301 (1947).—Attempts to establi electrodes suitable for the determination of th activity of Na^+, K^+, Ca^{++}, etc., in plant tissues an soils is discussed. The theory of the glass electro is developed in terms of an adsorption equilibriu (the glass is assumed to function as a weak acid) presence of Na^+ as well as H^+. The observe behaviour of various types of glass in glass electrod is discussed and related to this theory. On changi the glass composition the sensitivity to other io than H^+ may be altered. Information on the activi of these ions may thus be derived. J. O'M.

541.135

5741. The use of silver–silver chloride referen electrodes in dilute solutions. GILBERT, P. T. *Dis Faraday Soc.* (*No.* 1) 320–5, *disc.* 325–7 (1947).—T use of the Ag/AgCl electrode in solns. containing low conc. of Cl^-ions (as little as 10 p.p.m.) is appli to problems in corrosion. The significance of t potentials measured is discussed from the points view of (1) the concentration of the solution, (2) t variation of temp., and (3) the comparison of potenti measurements at different temps. Experiment observations and theoretical calculations of the effe of temp. and conc. are compared. J. O'M.

541.135

5742. Direct observation of variations in electro potentials by means of the cathode-ray oscillograp LEBBINK, F. J., WEYDEMA, J. AND BURGERS, W. *Rec. Trav. Chim. Pays-Bas*, **68**, 397–406 (*June*, 194 *In English.*—The rapid variations in potential of t electrodes in an electrolytic cell when closing interrupting the current were made visible on t screen of a c.r.t. as a repeating image. This w achieved by using a periodically interrupted curre

btained by means of an electronic interruptor. dication of time was realized by means of a periodic ppression of the cathode ray. A particular feature the measuring equipment is the possibility of mplete synchronization of its different parts. A.

541.135.5

743. The hydrogen electrode. HILL, G. J. AND ES, D. J. G. Letter in *Nature, Lond.*, **163**, 997 *une* 25, 1949).—The potential of the hydrogen ectrode is linearly dependent on the depth of the ubbling jet below the surface of the solution owing the supersaturation produced by the excess bubble ressure. Experiments show that the excess pressure rrection is 0·42 ± 0·02 times that for the total ydrostatic head above the jet. The correction of any accurate electrode potential measurements to ero bubble depth would cause a shift of 0·02–·08 mV. J. O'M. B.

541.135.6

744. Studies in electrolytic polarization. II. The fect of the solvent on the hydrogen overpotential (i). OCKRIS, J. O'M. *Disc. Faraday Soc.* (*No.* 1) 95–106, *isc.* 127–40 (1947).—The overpotential on Pb, Cu and i cathodes measured at c.d.'s mainly from 10^{-3}–$)^{-1}$ amp/cm² in solutions of HCl in CH_3OH, C_2H_5OH, hylene glycol, formic acid, acetic acid, ether and ioxane and mixtures of these with H_2O is reported ith comprehensive details of technique used. ong time decay and the effect of stirring are also vestigated in these systems. On Pb the over-otential at a given c.d. is generally lowered in non-queous solvents and passes through max. and min. t intermediate solvent compositions. On Ni there generally a smaller effect and the tendency is for n increase to occur on addition of the non-aqueous omponent. The solvent effect on Cu is similar to hat for Pb. The shape of the Tafel lines is affected o a limited extent by the solvent in all the cases tudied. The results cannot be satisfactorily inter-reted on existing neutralization or reaction rate heories. A more probable basis at least for the esults on Ni electrodes is connected with the dsorption of the non-aqueous component of the olution by the cathode and the action of such a ayer as a negative or positive catalyst (under varying oncentrations on the surface) to the $H + H \rightarrow H_2$ eaction, suggesting that a slow catalytic process is perative at certain of the cathodes studied. J. O'M. B.

541.135.6

745. The polarization of platinised platinum lectrodes in dilute hydrochloric acid. BRYANT, P. M. ND COATES, G. E. *Disc. Faraday Soc.* (*No.* 1) 15–22, *disc.* 127–40 (1947).—Results for the polariza-ion of Pt/Pt electrodes in a range of HCl solutions rom 0·01 N to 0·05 N at 25° are given. Their elation to the current density is not linear but the urves have a max. between 0·6 and 0·8 V and an nflection between 0·3 and 0·5 V. The relation of he time after cessation of current to the residual olarization indicates a transition between two lectrode processes which is claimed to correspond o the inflection on the log c.d. *v.* polarization urves. The effect of ageing by prolonged polariza-ion on the behaviour of the electrode on switching ff the current is observed; a fresh electrode decays rapidly initially to a low potential while an aged electrode gives a constant potential for about $\frac{1}{100}$ sec initially and then decays rapidly. The fact that the state of the electrode alters the nature of the time decay indicates that the potentials observed are not due to concentration polarization (i.e. not due only to concentration changes in the solution). No satisfactory interpretation of the results can yet be given. J. O'M. B.

541.135.61

5746. Some electron transfer processes in heterogeneous systems. I. Electrodeposition of hydrogen. WEISS, J. *Disc. Faraday Soc.* (*No.* 1) 68–71, *disc.* 127–40 (1947).—The deposition of H at an electrode is considered on the basis of the mechanism of the electron transfer from the interior of the metal in various stages to the H ion and the recombination of adsorbed H. It is shown that for typical metals of low overvoltage $b = 2{\cdot}3RT/F$ while for typical metals of high overvoltage $b = 2\times2{\cdot}3RT/F$. When the surface of the metal is covered with H atoms $b = \frac{1}{2} \times 2{\cdot}3RT/F$. These represent extreme cases and it is suggested that it is possible to obtain all values of b between them. J. O'M. B.

541.135.7

5747. Retarded electrodeposition of metals studied oscillographically with mercury capillary electrodes. HEYROVSKÝ, J. *Disc. Faraday Soc.* (*No.* 1) 212–23, *disc.* 223–4 (1947).—Investigation of the deposition of metallic ion in different electrolytes at a streaming Hg cathode (obtained using a special apparatus) by an alternating (rectangular) voltage is carried out, using a c.r.o. The potential-time and first derivative (∂ potential/∂T) curves are obtained for a variety of ions. Two types of behaviour are observed, associated with the number of electrons taken up by the ions. Some processes ("oscillographically reversible") give kinks at the same "cathodic" and "anodic" potentials, while for others ("oscillographically irreversible") these kinks occur at different potentials on the "cathodic" and "anodic" branches of the curve. The ions studied give these types of behaviour under varying conditions (some exhibiting only one type) and are classified according to this behaviour. In some cases the addition of foreign ions (e.g. Cl^- and Br^-) causes the irreversible process to become reversible and increases the rate of deposition. Raising the temp. or lowering the freq. of the a.c. pulses are found to decrease the difference between the potential values on the "cathodic" and "anodic" branch. The presence of adsorbed films of molecules in some cases caused reversible processes to function irreversibly and this effect was counteracted by the addition of Cl^-, etc., ions. It is suggested that these phenomena are due to retarded acceptance of more than one electron, due to a consecutive process, a second electron being acquired by dismutation between two singly charged ions at the electrode. J. O'M. B.

541.136.5

5748. The discharge of the zinc–lead dioxide cell. BECK, W. H. AND WYNNE-JONES, W. F. K. *Disc. Faraday Soc.* (*No.* 1) 285–93, *disc.* 298–301 (1947).—The effect of varying the nature of the cell electrolyte, the temp. and rate of discharge on the cell capacity

is examined for an ordinary Pb dioxide electrode. The effect of the rate of discharge on the capacity of a cell containing a differently prepared PbO_2 electrode is also investigated. The methods of preparing the two types of electrode are given in detail. It is found that the effects of the 3 variables are interdependent and the interpretation of the results is consequently involved. It seems that an increase of the internal resistance of the cell during discharge due to coating of PbO_2 particles with a protective substance (e.g. sulphate or phosphate) forms a basis for the explanation of some of these effects. The variation of effective surface area of PbO_2 between the two electrodes prepared in different ways would result in a different extent of this "protection" during discharge. As an approximation the change in internal resistance for a given stage of the discharge is $\propto$ the value of the external resistance, which is in qualitative agreement with the results. J. O'M. B.

541.138

5749. Reactions at mercury cathodes. HOOGLAND, J. G. *Disc. Faraday Soc.* (*No.* 1) 200–3, *disc.* 223–5 (1947).—A possible explanation for the "anomalous" formation of Na amalgams by electrolysis of NaCl solution at a Hg cathode is given and is based on the presence of atomic H at the Na amalgam cathode. Evidence for this is found in the presence of cavities in iron "decomposers" used in NaCl/Hg electrolytic cells, and in a technical method for the production of peroxide compounds from Na amalgam and O.

J. O'M. B.

541.138

5750. Recent applications of controlled potential electrolysis. LINGANE, J. J. *Disc. Faraday Soc.* (*No.* 1) 203–12, *disc.* 223–4 (1947).—An apparatus for controlled potential electrolysis (a "potentiostat") and its uses in electrochemical analysis and preparations are described. Electrolytic separations of interfering metals in polarographic determinations may be accomplished with little manual control. This method is used in analysis of solutions containing Cu, Bi, Pb and Cd, Sn, Ni and Zn, and satisfactory results obtained. The use of controlled potential electrolyses in coulometric analysis is found to give rise to results about as accurate as for electro-gravimetric titrations and may be used in solutions containing several reacting species. This is extended to use in determinations of polarographic reduction states where the number of electrons per molar unit of reduction is large. The preparation of 9-(*o*-iodophenyl)dihydro-acridine by selective reduction of 9-(*o*-iodophenyl)acridine is possible by a method described using controlled potential electrolysis and many similar organic preparations may be carried out by this method which are difficult to accomplish in any other way. Experimental details are given. J. O'M. B.

541.138

5751. Some anomalies in the concept of electrode potential as the determining factor in the occurrence of anodic reactions. HICKLING, A. *Disc. Faraday Soc.* (*No.* 1) 227–9, *disc.* 248–53 (1947).—The fact that some anodic electrode processes occur at a more positive potential than that at which another reaction which is possible under the same conditions would occur is presented as an anomaly. The fact that t reaction determines the electrode potential and not t electrode potential which determines the reaction emphasized. J. O'M.

541.1

5752. Investigation of electrode reactions by t method of charging-curves and with the aid of alternati currents. ERSHLER, B. *Disc. Faraday Soc.* (*No.* 269–77, *disc.* 298–301 (1947).—As a means of studyi the kinetics of formation of H and O layers at electrode the variation of the potential with t amount of current passed is observed for sever metals with either slow charging (allowing adsorpti layers to come to equilibrium) or rapid charging (i such equilibrium). Rates of removal and formati of adsorbed films may be determined. The slo charging technique applied to Pt and Pt/Pt show that the strength of the metal/O bond increases wi time and in the case of Pt and Ag the oxidati process affects the adsorption properties of the me surface. The rapid charging technique showed th the formation of an adsorbed layer of O on Pt is slower process than the formation of a similar lay of H. The presence of Cl^- ions inhibits the deposition. The capacity and conductance of electrode with a.c. passing is treated theoretica and 3 types of behaviour are found. The velocity the electrode process and the role of the diffusi stage and the electrode reaction rate in the kineti of this process may be deduced. Discharge of H ions and adsorption of Cl ions on a Hg surface a rapid reactions. The mechanism of anodic d solution and passivation of Pt in presence of C ions is discussed. Passivation is not attributed to t formation of protective oxide layers but to the effe of the O layer on the electric field of the doub layer. J. O'M.

541.1

5753. Electrode reactions in the aluminium r duction cell. PEARSON, T. G. AND WADDINGTON, *Disc. Faraday Soc.* (*No.* 1) 307–20, *disc.* 325–8 (1947). The characteristic features of the Al reduction c operating smoothly in the normal ("down") conditi are studied. Both experimental work and theoreti arguments, new and previously published, a discussed. The nature of the electrolyte of molt cryolite is established as a mixture of cryolite, N fluoride and Al fluoride. Na is detected in the formed. The degree of dissociation of the cryoli and its temp. variation are calculated and the val obtained compared with experimental data. Observ tions of concentration changes show that conducti in the electrolyte is by Na^+ and AlF_6''' ions. T cathode reaction is largely the discharge of Al^{+++} ions derived from alumina, Na ions may also discharged and react with the flux to produce A At the anode the initial product is $\sim$ 100% CO_2 100% current efficiency and the O carried out of t cell as CO_2 and CO is equivalent to the amount Al liberated at the cathode. The formation of metallic fog (of Na) at the cathode which diffuses the anode causes reduction of CO_2 to CO. T oxidized fog constituent reacts with the flux to for alumina and the CO_2 content of the anode gases determined by the current efficiency at which the c

working. When the cell is running in the "up" ndition the proportion of CO is increased, and orocarbons are released. J. O'M. B.

PHOTOCHEMISTRY 541.14

541.14

54. The autoxidation of tetralin. BAMFORD, C. H. ID DEWAR, M. J. S. *Proc. Roy. Soc. A*, **198**, 252–67 *ug.* 15, 1949).

541.144

55. The mechanism of the photo-chemical de-mposition of diethyl ketone. DOREMAN, L. M. AND ELDON, Z. D. *J. Chem. Phys.*, **17**, 511–15 (*June*, 49).

OLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18

56. Colloid physics. MÜLLER, F. H. AND RBRING, H. *FIAT Rev. German Sci.* (1939–46) *Physics of liquids and gases*" [*Off. Mil. Govt. Ger-any*] 267–330 (1948) *In German.*—An exhaustive view of German research work between 1939 and 46, with a complete bibliography. Subjects scussed are: (1) types of colloidal systems, (2) size d shape of the particles, (3) surface phenomena,) macromolecules, (5) mechanical and thermal haviour, (6) optical and electrical behaviour,) viscosity of colloids. [See also Abstr. 5284 949)]. L. S. G.

541.182

57. Diffusion and osmotic coefficients, con-uctivity, membrane analyses, and the determination of icellar charge and composition in some colloidal ectrolytes. CHANDLER, R. C. AND MCBAIN, J. W. *Phys. Coll. Chem.*, **53**, 930–44 (*June*, 1949).

541.182.5 : 539.374

Measurement of the elasto-plastic properties of gels. *e Abstr.* 5708

ADSORPTION 541.183

541.183

58. Statistical mechanics of adsorption. V. hermodynamics and heat of adsorption. HILL, T. L. *Chem. Phys.*, **17**, 520–35 (*June*, 1949).—The thermo-ynamics of an adsorbate on an inert adsorbent is scussed in some detail. Heats of adsorption are ven particular attention in an attempt to clarify and tend the available methods in this field. It is found at the true equilibrium $\Delta H = T\Delta S$ of adsorption r adsorbate molecules is given by $(\partial \ln p/\partial T)_\phi = -\Delta H/RT^2$, where ϕ is the two-dimensional spreading essure. A.

541.183.02

59. Measurement of the adsorption of surface-tive agent at a solution-air interface by a radiotracer ethod. DIXON, J. K., WEITH, A. J., JR., ARGYLE, A. A. AND SALLEY, D. J. Letter in *Nature, Lond.*, **163**, 845–6 (*May* 28, 1949).—A surface-active agent (di-*n*-octyl sodium sulphosuccinate) and sodium sulphate were each synthesized with S^{35}. Activity measurements were made by placing G.M. counters above the surfaces of aqueous solutions of the two substances. The solutions had identical molar concentrations and specific activities. Since the sulphate is not adsorbed at the surface a comparison of the two measurements gave the amount of surface-active agent adsorbed in the surface. By varying the concentrations (from 0·1 to 150×10^{-8} moles/cm³) a well defined adsorption isotherm was obtained and is reproduced. The results indicate that for this agent an increase in bulk concentration beyond the point necessary to give a mono-molecular layer leads to still further adsorption at the surface. Other applications of this technique are indicated. J. I.

541.183.02

5760. Surface chemistry. VARIOUS AUTHORS. *London, Butterworth's Scientific Publications*, (1949) *pp.* vii + 334. *In English or French.*—Papers presented at a joint meeting of the Société de Chimie Physique and the Faraday Society at Bordeaux in Oct. 1947. Subjects covered include: hygroscopicity of mono-layers, superficial thermodynamics, a 2-dimensional phase rule, transformations of different orders in monolayers, the structure of condensed monolayers, kinetics of adsorption at liquid surfaces, desorption of monolayers, surface tension measurements, properties of adsorbed films, films on solid surfaces.

541.183.02 : 532.6

Depth of the surface zone of a liquid surface. *See Abstr.* 5277

541.183.5 : 537.585

5761. Application of the method of modulated molecular bursts to the investigation of adsorption phenomena. STARODUBTSEV, S. V. *J. Exp. Theor. Phys., USSR*, **19**, 215–24 (*March*, 1949) *In Russian.*—For the experimental determination of the probability of evaporation of adsorbed atoms from the surface of incandescent metal, a method using modulated atomic or molecular rays directed towards the adsorbing filament is suggested. The time-variation of the positive ion current from the filament permits the probability of evaporation of an adsorbed atom within 1 sec, and the evaporation heat of an ion and an atom, to be determined. The method was verified for the case of the K and Na adsorption on W, and the adsorption heats were found to be $\lambda_{K^+} = 2{\cdot}52$ eV and $\lambda_{Na^+} = 3{\cdot}3$ eV, respectively. B. F. K.

CHEMICAL STRUCTURE 541.4/.6

541.57

5762. The dissociation energy of the N–N bond in hydrazine. SZWARC, M. *Proc. Roy. Soc. A*, **198**, 267–84 (*Aug.* 15, 1949).—The thermal decomposition of hydrazine was investigated over a temperature range of 630 to 780°C and at pressures of a few mm Hg. The experiments were carried out in a flow system, toluene being used as a carrier gas. Assuming that

the recombination of NH_2 radicals does not involve any energy of activation, it is found that $D(NH_2–NH_2) = 60 \pm 3$ kcal/mole. This value in conjunction with the relevant thermochemical data leads to the heat of formation of NH_2 radical as 41 kcal/mole and to $D(NH_2–H) = 104 \pm 2$ kcal/mole. The latter is good evidence in support of Gaydon's value of 225 kcal/mole for the heat of dissociation of N_2. A.

541.6

5763. New evidence on the structure of some proteins from measurements with polarized infra-red radiation. AMBROSE, E. J., ELLIOTT, A. AND TEMPLE, R. B. *Nature, Lond.*, **163**, 859–62 (*June* 4, 1949).—Parallel dichroism of the N–H stretching frequency (*c.* 3 300 cm^{-1}) is observed in α-keratin and related compounds, in contrast to β-keratin, and is explained by a proposed model of the polypeptide chain in the α-fold. D. H. W.

541.64

5764. The effect of non-homogeneity of molecular weight on the scattering of light by high polymer solutions. BRINKMAN, H. C. AND HERMANS, J. J. *J. Chem. Phys.*, **17**, 574–6 (*June*, 1949).—The general theory of the turbidity of a mixture of many components is applied to a solution of homologous polymers. It is found that the concentration dependence of the turbidity is intimately related to that of the osmotic pressure. The molecular weight distribution does not have any influence on the concentration dependence of the turbidity. A.

541.64

5765. Polymerization in the solid state. MILLER, E., FANKUCHEN, I. AND MARK, H. *J. Appl. Phys.*, **20**, 531–3 (*June*, 1949).—The melting point of ε-carbobenzoxy-α-carboxyl-*l*-lysine anhydride stored at room temp. for one year (I) rises considerably above that of the freshly prepared compound (II) (m.p. 100°). X-ray diffraction studies indicate: (II) is probably monoclinic, $a \simeq 90$ Å, $b = 5$ Å, $c \simeq 10$ Å; (I) suffered disorientation giving diagrams similar to those of bulk polymer (III); threshold conditions for the disorientation process are heat-treatment of (II) at 70° for 24 hr; the change appears to be complete when (II) is heat-treated at 85° for 24 hr since the diagrams are similar to those of (III) and no further change is observed in the diagrams of samples treated under more severe conditions below the m.p. The largest Bragg spacing of 29 Å observed for (II) is of the same order of magnitude as the overall length of a fully extended H-bonded dimer of (II). The smallest refractive index of (II) is parallel to the *b* axis. The structure of (II) is concluded to be a triple dimer layer arrangement which would involve a relatively small entropy change on polymerizing in the solid state to give (I) and (III). A.

541.64

5766. Dilatometric studies of high polymers. I. Second-order transition temperature. KOLB, H. J. AND IZARD, E. F. *J. Appl. Phys.*, **20**, 564–71 (*June*, 1949).—By means of a density balance, the relationship between intrinsic viscosity and dilatometric properties is established for polyethylene terephthalate. The most pronounced property change associated with increasing intrinsic viscosity was observed to be the second-order transition temperature. T relationship between crystallinity and dilatomet properties is presented for 3 aromatic polyeste In every case, increased crystallinity in the polym is associated with higher second-order transiti temps., larger transition range, higher density, a lower volume coeffs. of expansion. Second-orc transition temps., densities at 0°C, and volume coeffs. of expansion are presented for a number polyesters and vinyl polymers to illustrate the effe of chemical structure as well as physical state on the dilatometric properties. Illustration of the effect copolymerization on second-order transition tem is made with a copolyester system.

541.

5767. Dilatometric studies of high polymers. Crystallization of aromatic polyesters. KOLB, H. AND IZARD, E. F. *J. Appl. Phys.*, **20**, 571–5 (*Jun* 1949).—By means of both a density balance a gradient tube, experimental density data are obtain to illustrate the thermal crystallization behaviour 3 aromatic polyesters at temps. from 90°C to 150 The data are discussed with reference to both amou and rate of crystallization and density curves a presented to show qualitative similarity betwe kinetics of polymer crystallization and the kinetics chemical reactions. From the experimental data, temp., for convenience labelled the minimum cryst lization temp., is described and is shown to be 3 to 50° above the second-order transition temp. for t polyesters. In addition to thermal crystallizatio data are presented to show that immersion media m initiate crystallization below the minimum tem associated with thermal crystallization of polyme Liquids used as immersion media for polyethyle terephthalate were water, methyl alcohol, aceto benzene, nitromethane and nitric acid. The last liquids initiate crystallization of the polymer room temp.

541.64 : 534.

Propagation of audiofrequency sound in high po mers. *See Abstr.* 5305

541.64 : 534.321

Transition temperatures of methyl methacryla polymers at ultrasonic frequencies. *See Abstr.* 5312

541.64 : 534.321

Propagation of ultrasonic bulk waves in high po mers. *See Abstr.* 5313

541.64 : 536.

5768. Equation of state for polystyrene. SPENCE R. S. AND GILMORE, G. D. *J. Appl. Phys.*, **20**, 502 (*June*, 1949).—Practical considerations emphasize t desirability of formulating an adequate equation state for polystyrene. A fairly satisfactory one is t simplified version of van der Waals' equatio $(P + \pi)(V - \omega) = nRT$, where π is the interr pressure (or cohesive energy density) and ω is t volume at absolute zero, by extrapolation. Evaluati constants from thermal expansion data and expressi P in p.s.i., V in cm^3/g, and T in degrees Kelvin, t becomes $(P + 27\,000)(V - 0{\cdot}822) = 11{\cdot}6T$. Agr ment with compressibility measurements, which a described in some detail, is good. Discrepancies w room temp. values of sound velocity and cohes

ergy density by swelling measurements are dis-sed briefly. A.

541.64 : 539.32

Dynamic measurements of polymer physical pro-rties. *See Abstr.* 5698

541.64 : 539.32

Creep and damping properties of polystyrene. *e Abstr.* 5699

CHEMICAL APPARATUS 542.1/.7

542.48 : 534.321.9

69. The effect of sound waves on fractional tillation. COFFIN, C. C. AND FUNT, B. L *J. Phys. ll. Chem.*, **53**, 891–4 (*June*, 1949).—The presence standing ultrasonic waves in distillation columns es a slight increase in separation of components. A.

CHEMICAL ANALYSIS 543/545

545.3

70. Ion-exchangers to separate, concentrate and rify small amounts of ions. COHN, W. E., PARKER, W. AND TOMPKINS, E. R. *Nucleonics*, **3** (*No.* 5) –33 (*Nov.*, 1948).—A general description is given a remotely-controlled ion exchange apparatus by hich 100–1 000 mc amounts of individual cationic fission products could be extracted, with a total solid content < 5 mg. Concentration of samples was achieved, after the initial separation, by reabsorption on a second ion-exchanger, the process being controlled by adjustment of *p*H. Records of actual separations are given and discussed. A. P. F.

545.37

5771. Polarography with slowly forming mercury drops. SMITH, G. S. Letter in *Nature, Lond.*, **163**, 290–1 (*Feb.* 19, 1949).—Polarographic current-time and current-voltage curves have been studied at drop-times of from 16 sec to 8 min using a short capillary of orifice radius 108 μ with ordinary polarographic equipment. The current-time curves with sodium sulphite and zinc sulphate in O-free KCl solution show inversions of shape at potentials corresponding to the electrocapillary maximum and the deposition of Zn. Current peaks, which are not polarographic maxima, occur in current-voltage curves for single drops during a reduction. The height of the peak is linearly related to the drop-volume, but is independent of drop-rate. If the voltage is increased at the same size of drop growth in solutions containing various amounts of reducible matter the peak height is $\propto$ the concentration. J. O'M. B.

545.82

5772. Cathodo-luminescence of rare earths in coal ash. MUKHERJEE, B. Letter in *Nature, Lond.*, **163**, 402 (*March* 12, 1949).—Rare earths in various coal ashes in insufficient quantities for detection by arc spectrographic methods were easily detected by mixing with calcium oxide and examination of their cathodo-luminescent spectra. C. C.

CRYSTALLOGRAPHY 548

548.0 : 535

73. Optical properties of barium titanate. CROSS, E., DENNISON, A. T., NICOLSON, M. M. AND HIDDINGTON, R. Letter in *Nature, Lond.*, **163**, 635 (*April* 23, 1949).—See also Abstr. 5798 (1949). etragonal $BaTiO_3$ crystals are twinned; application an electric field tends to turn $c \parallel$ to the field, timately producing a single crystal. A field proaching breakdown raises the tetragonal $\rightarrow$ cubic ansition temp. from 121° to 130° C. The birefringence is about 0·055 at 0°, decreasing to 0·02 at the ansition point, where it drops to zero. It is given pproximately by $\Delta\mu = 5{\cdot}5\,(c/a - 1)$, where c/a is e axial ratio [see Abstr. 1055 (1947)]. A. J. C. W.

548.0 : 539.32

74. Elasticity of zinc crystals. WERT, C. A. AND YNDALL, E. P. T. *J. Appl. Phys.*, **20**, 587–9 (*June*, 949).—Young's modulus, E, has been measured by ynamic and static methods for 25 Zn single crystals. he results fit a parabolic curve when $1/E$ is plotted gainst the square of the cosine of the orientation. rom the constants of this curve and earlier data on near compressibility by Bridgman, are derived umerical values for the coeffs. of compliance of the n crystal, as follows: $S_{11} = 8{\cdot}38$, $S_{12} = 0{\cdot}5$, $_{13} = -7{\cdot}31$, $S_{33} = 28{\cdot}4$, $S_{44} = 26{\cdot}1$, all $\times 10^{-13}$ cm²/dyne. Data on 3 crystals were taken from room temp. to 375°C. From these may be computed Young's modulus for any orientation and any temp. in the range given. Young's modulus decreases for all orientations with increasing temp. A.

548.0 : 539.32 : 535.55

5775. Investigation of the mechanical and piezo-optical properties of silver chloride crystals. TSOBKALLO, S. O. *J. Tech. Phys., USSR*, **19**, 507–17 (*April*, 1949) *In Russian.*—In his investigations of the mechanical properties of AgCl by stress-optical methods which have to rely on the knowledge of the basic mechanical and piezo-optical characteristics, the author found that literature contained only data on mono-crystals, whilst poly-crystals had not been studied before. The paper fills this gap. For poly-crystalline AgCl of 1·5–2 mm grain size the following values were found: Elastic limit 42 g/mm²; resistance to rupture 1 100 g/mm²; effective rupturing strength 1 500 g/mm²; relative elongation 40%; lateral contraction in neck 30%; a special characteristic is the strain-hardening of AgCl after plastic deformation at room temperature, and also the high plasticity at room temperature. The piezo-optical coefficient remains constant at plastic deformation up to 20%. This enables stress optical investigations to be carried

through in this range. The optical coefficient of AgCl varies in the plastic range between 250×10^{-6} mm²/kg to 500×10^{-6} mm²/kg in dependence on the orientation of the crystal. The outstanding characteristic of the piezo-optical properties of AgCl is its high optical activity, which places it among the materials of the highest optical activity now known (bakelite). B. F. K.

548.0 : 539.37

5776. Deformation of single crystals of tin in solutions of oleic acid. KEMSLEY, D. S. Letter in *Nature, Lond.*, **163**, 404 (*March* 12, 1949).—Rehbinder [*C.R. Acad. Sci., USSR*, **32** (2) 125 (1941)] reports a 50% decrease in the yield value of single crystals of Sn and Zn when immersed in a 0·2% soln. of oleic acid in a non-polar paraffin oil; and a 5-fold increase in the electrical resistance of a single crystal of Sn when elongated almost to fracture in the same solution, compared with its resistance under the same conditions in air. No such effects were observed by the author with single crystals of Sn of several orientations immersed in 0·2% solutions of oleic acid in various paraffins. J. A. F.

548.0 : 539.4

5777. On the cleavage phenomenon. STEPANOV, A. V. *J. Tech. Phys., USSR*, **19** (*No.* 4) 492–506 (*April*, 1949) *In Russian.*—It is pointed out that the prerequisite conditions of the occurrence of cleavage phenomena in crystals are to be found in an anisotropy of the elastic properties. This is investigated in detail and brought out by the fundamental dissimilarity of the stress diagrams along the principal axes of the crystal. The role of stress concentration is elucidated, and exceptions indicated, i.e. cases where no cleavage occurs despite concentrated stressing. The special part deals with cubic and rhombic crystal systems, in particular with Mg, Zn, Cd and Be crystals. B. F. K.

548.24

5778. Straight twin lamellae in aluminium single crystals. DALÏTZ, V. C. AND BURGERS, W. G. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 6) 627–8 (1949) *In English.*—These lamellae are rare in Al but common in other metals. The occurrence of straight twin bands may be related to the presence of a pronounced preferential orientation in the recrystallizing material, which is rarely the case for recrystallized polycrystalline Al. A pronounced texture was produced by deforming single crystals; straight twin lamellae were obtained on recrystallization. J. A. F.

548.4

5779. One-dimensional dislocations. I. Static theory. FRANK, F. C. AND VAN DER MERWE, J. H. *Proc. Roy. Soc. A*, **198**, 205–16 (*Aug.* 15, 1949).—The theory of a one-dimensional dislocation model is developed. Besides acting as a pointer to developments of general dislocation theory, it has a variety of direct physical applications, particularly to monolayers on a crystalline substrate and to conditions in the edge row of a terrace of molecules in a growing crystal. Allowance is made in the theory for a difference in natural lattice-spacing between the surface layer or row and the substrate. The form and energy of single dislocations and of regular sequences of dislocations are calculated. Critical conditions for spontaneous generation (or escape) of dislocations are determined, and likewise the activation energies for such proces below the critical limits. Various physical applic tions of the model are discussed, and the physi parameters are evaluated with the aid of the Lennar Jones force law for the above-mentioned princi applications.

548.5 : 536.421

5780. Behaviour of crystal boundaries in aluminiu and its alloys during melting. PUMPHREY, W. I. A LYONS, J. V. Letter in *Nature, Lond.*, **163**, 960 (*June* 18, 1949).—The temp. of incipient melting the crystal boundaries in bars of annealed pure and of the alloys Al–Cu, Al–Fe and Al–Mg is ~ 4 below that of the metal in mass. This may be due the atomic disorder or to concentration of impurit at the boundaries. J. A.

548.

5781. Nucleation of centres of crystallization supercooled liquids. V. Spontaneous crystallization liquids. DANILOV, V. I. *J. Exp. Theor. Phys., USS* **19**, 235–41 (*March*, 1949) *In Russian.*—See Abs 3567–8 (1949). A new classification of liqui according to their tendency to supercool is su gested; the results of a series of experimental investig tions are compared with fluctuation theory where deals with spontaneous nucleation; the surface (interface) tension between nucleus and liquid estimated as well as the activation energy at t transition of a molecule from the liquid into t crystal nucleus. B. F.

548.5

5782. Role of dislocations in crystal growt BURTON, W. K., CABRERA, N. AND FRANK, F. Letter in *Nature, Lond.*, **163**, 398–9 (*March* 12, 1949). The observed rate of growth of a crystal from a vapo exceeds the theoretical value by a factor $\varepsilon^{3,100}$ [*s* misprint for $\varepsilon^{0\cdot31}$?]. This discrepancy is due to t dislocation structure of real crystals. Rows of ato are permanently exposed on the surface, eliminati the need for fresh two-dimensional nucleation. J. A.

548.523 : 621.396.611.

5783. Growing crystals of ethylene diamine tartra WALKER, A. C. AND KOHMAN, G. T. *Trans. Am Inst. Elect. Engrs*, **67**, 565–70 (1948).—The rocki tank method of crystal growing so often applied Rochelle salt is not successful and a rotary meth has been developed. Crystal seeds are mounted a framework rotating with a reciprocating motion a saturated solution of EDT. The seeds are pr pared by the selection of small crystals spontaneous formed in normal crystallization. The large crysta so produced are then cut into seed plates and se caps and replanted in the crystallizer to form furth crystals which are then processed into the fin crystal filters. For pilot plant production, a 3-sta constant temp. process is employed, in which granul EDT is added to one tank, made into a saturat solution and passed into a growing tank, the weakene unsaturated solution being pumped back to a thi tank for replenishment. The whole process is aut matic. After growing, the final crystals are draine aged for 24–48 hr and then removed for processing. E. D. H. (

548.538 : 548.7

784. Structural interpretation of orientated overgrowths in crystallization. DEICHA, G. A. Letter in *Nature, Lond.*, **164,** 68–9 (*July* 9, 1949).—The orientation of KCl on muscovite depends on agreement of the spacing of K ions along one direction common to the two crystals, not on agreement over the whole plane of contact. A. J. C. W.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

785. Study, by the coupling method, of the fundamental oscillations of an assembly of identical atomic groups. COUTURE, L. AND MATHIEU, J.-P. *J. Phys. Radium*, **10,** 145–50 (*May*, 1949) *In French.*—Group theory is applied to deduce the types of oscillation possible for the atomic groups (radicals, ions, molecules) making up an assembly (molecule, crystal lattice). Results for the 32 crystal classes are given in a table; $NaClO_3$ and $Pt(CN)_4$ are treated in some detail. A. J. C. W.

548.7 : 537.226

786. Lattice theory of dielectric and piezoelectric constants in crystals. HUANG, K. *Phil. Mag.*, **40,** 733–47 (*July*, 1949).—Born's perturbation method for treating long acoustic lattice waves becomes invalid when Coulomb interactions between charged lattice particles are taken into account. It is shown that after the separation of a term by Ewald's theta-function transformation from the lattice restoring force, the method can still be used. The new wave equation contains an extra term, and is identical with the rigorous elastic wave equation for a piezoelectric crystal. The comparison gives expressions for the dielectric and piezoelectric coefficients and for the elastic constants. L. S. G.

548.7 : 539.4

787. Theory of stability of binary lattices. KHDANOV, V. A. AND VISHNEVSKAYA, N. L. *J. Exp. Theor. Phys., USSR*, **19,** 231–4 (*March*, 1949) *In Russian.*—The stability of a binary, space-centred lattice was investigated under the assumption of a conservative system of bond forces. It could be shown that on the transition from a monatomic lattice, which is unstable owing to the absence of resistance against dislocations, to the binary lattice, a strong resistance against dislocations is already set up at a very small distance of the particles. B. F. K.

548.73

788. Effect of temperature variation and electric field on X-ray intensity reflected from Rochelle salt crystal. II. The effect of electric field. MIYAKE, S. *Proc. Phys.-Math. Soc. Japan*, **23,** 810–19 (1941).—The effect of the electric field on the X-ray intensities reflected from some net planes of the Rochelle salt was studied by using the double crystal ionization spectrometer. An intensity change with field was detected. This change was explained as due to the variation of the secondary structure of the crystal by the field. It is concluded that the change cannot be ascribed to any change in the structure factor. S. C. A. P.

548.73 : 535.3 : 537.531

Effect of H atoms on intensities of X-ray reflections. *See Abstr.* 4007

548.73 : 537.531 : 535.339

A new bent-crystal X-ray monochromator. *See Abstr.* 5456

548.732 : 537.531 : 535.42

5789. Diffraction of X-rays in aluminium due to thermal agitation. OLMER, P. *J. Phys. Radium* (*Sér.* 8) **10,** 72–84 (*March*, 1949) *In French.*—The diffraction of monochromatic X-rays by single crystals is caused partly by selective Bragg reflection and partly by a general weak diffraction which is due to the Compton effect, to imperfections of the crystal and to thermal agitation. The latter has been investigated separately and the velocity and frequency of elastic longitudinal and transverse waves propagating in monocrystals of Al have been determined. A vibration spectrum of the crystal has been derived and a value for the specific heat has been evaluated which agrees well with that found by other methods. R. H. H.

548.732 : 537.531 : 535.42

5790. Relative phases of diffraction maxima by multiple reflection. LIPSCOMB, W. N. *Commun. in Acta Cryst.*, **2,** 193–4 (*April*, 1949) *In English.*—Interference between the direct $\mathbf{h}_3$ reflection and the indirect double reflection $\mathbf{h}_1$ followed by $\mathbf{h}_2$, where the reciprocal-lattice vectors satisfy $\mathbf{h}_3 = \mathbf{h}_1 + \mathbf{h}_2$, would in theory give information about the relative phases of the three reflections. Such interference effects have not been observed. They are not to be expected if the crystal is mosaic or if the incident beam diverges by more than a few seconds. A. J. C. W.

548.734

5791. Divergent-beam X-ray photography. MAY, W. Letter in *Nature, Lond.*, **163,** 569–70 (*April* 9, 1949).—[See Abstr. 1259, 5013 (1937); 2693 (1947)]. Hard radiation from a W target passes through a fine (0·03 cm) hole in a Pb screen and excites the characteristic radiation of a suitable metal foil placed in contact with the crystal to be investigated. A film perpendicular to the X-ray beam records the Laue and divergent-beam patterns of the crystal. A. J. C. W.

548.734

5792. An instrument for rapid determination of crystal orientation. GILLETTE, R. H. AND JELLINEK, M. H. *Rev. Sci. Instrum.*, **20,** 480–3 (*July*, 1949).—The rapid orientation of crystals is accomplished by the use of an apparatus employing a Geiger counter and X-ray focusing. The instrument can be used for precise orientation or to sort samples into various tolerance ranges. Applications to sapphire are discussed in detail. The instrument has also been used in connection with rutile and barium titanate orientations. A.

548.734 : 535.313 : 537.531

X-ray optics with doubly curved natural crystals. *See Abstr.* 5455

548.735.4

5793. Determination of absolute intensities of X-ray reflexions from relative intensity data. YÜ,

S. H. Letter in *Nature, Lond.*, **163**, 375–6 (*March* 5, 1949).—See Abstr. 2400 (1942). A factor for converting relative to absolute intensities is quoted, involving the relative intensities and quantities U_{nh}, of which a table is given. A test with *para*dinitrobenzene shows an error of 15%. A. J. C. W.

548.735.42

5794. On the systematic determination of the phases of X-ray diffraction waves in crystal-structure analysis. HOPPE, W. *Naturwiss.*, **35** (*No.* 8) 254 (1948) *In German.*—A large artificial temperature factor should be used, so that only a few structure amplitudes are appreciable. The signs of these are found by trial and error, the temperature factor is reduced to bring a few more structure amplitudes into the synthesis, the signs of these are found by trial and error, and the process repeated until all are included. A machine, especially suited for this process, is under construction. It will show the electron density at 516 points in a cell 27 cm square by needles moving vertically to form a "needle mountain." A. J. C. W.

548.735.44

5795. An extension of Banerjee's method for determining signs of Fourier coefficients. HUGHES, E. W. *Acta Cryst.*, **2**, 37–8 (*March*, 1949) *In English.*—Banerjee has given a linear relationship between certain structure factors, F_{hkl}, of a crystal which may be useful in determining their signs. His equation is applicable only to crystals containing but one kind of atom. In this note a similar equation is derived for "unitary structure factors," $\hat{F}_{hkl}$, which is applicable to any crystal. R. B. S.

548.736.3

5796. The crystal structure of α potassium hydroxide. ERNST, T. AND SCHOBER, R. *Nachr. Wiss. Göttingen* (*No.* 2) 49–52 (1947) *In German.*—Isomorphous with α-NaOH and TlI (B33), orthorhombic, space group D_{2h}^{17}, $a = 3{\cdot}95$, $b = 4{\cdot}03$, $c = 11{\cdot}4$Å, density $2{\cdot}04_6$, refractive indices $n_\alpha = 1{\cdot}486$, $n_\beta = 1{\cdot}492$, $n_\gamma = 1{\cdot}497$ for Na light. For K, $y = 0{\cdot}36$, and for OH, $z = 0{\cdot}11$. A. J. C. W.

548.736.3

5797. Crystal structure of $CoGe_2$ [and $PdSn_2$]. SCHUBERT, K. AND PFISTERER, H. *Naturwiss.*, **35** (*No.* 7) 222 (1948) *In German.*—Crystals of $Co_{0\cdot9}Ge_2$ are orthorhombic, pseudotetragonal, space group Bba, $a = b = 5{\cdot}650 \pm 3$, $c = 10{\cdot}800 \pm 3$ Å; 7 Co statistically distributed in two sets of 4(a), $z_1 = -0{\cdot}012 \pm 1$; $z_2 = -0{\cdot}238 \pm 1$; 16 Ge in two sets of 8(b), $x_1 = 0{\cdot}158 \pm 2$, $y_1 = \frac{1}{2} - x_1$, $z_1 = -\frac{1}{8}$; $x_2 = y_2 = \frac{1}{4}$, $z_2 = \frac{1}{8}$. $PdSn_2$ is of the same new structure type, with $a = b = 6{\cdot}478 \pm 3$, $c = 12{\cdot}155 \pm 3$ Å. A. J. C. W.

548.736.4 : 535

5798. Atomic positions and optical properties of barium titanate. KAY, H. F., WELLARD, H. J. AND VOUSDEN, P. Letter in *Nature, Lond.*, **163**, 636 (*April* 23, 1949).—Preliminary X-ray results sho that the Ti and O atoms in tetragonal $BaTiO_3$ a not displaced from the centres of symmetry (limit error 0·05 Å for Ti, 0·13 for O). The high dipo moment observed by Hulm [Abstr. 2887 (1947)] mu therefore be due to other causes, such as a displac ment of the outer electrons of the atoms. Th plates with the c axis in the plane of the plate usua contain thin ($\sim 10^{-4}$ cm) twins whose plane perpendicular to the plate and at $\sim 45°$ to c. The axes of the twins are $\perp$ to that of the main cryst The size of the twins can be varied by appropria electric fields; those with $c \parallel$ to the field are favoure The birefringence is about 0·05 below − 5°C, whe it increases suddenly to 0·06, then decreases linea with $c - \alpha$. Below − 5° $BaTiO_3$ is probab orthorhombic, below − 70° probably rhombohedra A. J. C.

548.7

5799. Crystal structure of cytidene. FURBERG, Letter in *Nature, Lond.*, **164**, 22 (*July* 2, 1949).

548.

5800. The reflection of proton waves from crys surfaces. YAMAGUTI, T. *Proc. Phys.-Math. So Japan*, **24**, 130–6 (1942) *In English.*—Diffracti patterns of proton beams by surfaces of galen zincblende and sodium chloride were taken, and th were classified into three kinds. The first kind patterns are similar to those obtained by Dempst [*Phys. Rev.*, **34**, 1493 (1929); **35**, 1405 (1930)]. T second kind are composed of two or several lin arranged at nearly equal distances and they a ascribed to the charging-up effect of the crystal. one pattern of the third kind, two lines are observ in superposition on the continuous background d to the scattering of the crystal, and the lines a explained as the reflection and the diffraction fro the surface. S. C. A.

548.

5801. The application of harmonic analysis electronography [electron diffraction]. WEINSTE B. K. AND PINSKER, Z. G. *Dokl. Acad. Nauk, SSS* **64**, 49–52 (*Jan.*, 1949) *In Russian.*—The diffracti of electrons by the potential (ϕ) in a crystal is co pared with the diffraction of X-rays by the electr density (ρ). The electron structure amplitu $\Phi(h,k,l) = (F^1 - F)/\pi H^2$, where F is the structu factor due to ρ and F^1 that due to nuclear scatteri $H^2 = h^2 + k^2 + l^2$. $\Phi(0,0,0)$ corresponds to t mean internal potential and can be found fro boundary refraction. Terms of the ϕ-series decrea more rapidly than those of the ρ-series. In princip H bonds may be detected. Patterson and Four projections of $BaCl_2 . H_2O$ illustrate the method. A. L. MA

GEOPHYSICS 55

550.376

5802. Natural electrical currents of the carboniferous region of Salins–Chandoline–Bramois near Sion (Valais). VALLET, J. *Arch. Sci.*, **2** (*No.* 1) 22–56 (1949) *In French.*—Geophysical mapping of an a which includes anthracite beds, is carried out potentiometer. The effects due to covering of beds water-table and recent deposits are examined. W. A.

550.38 : 530.1

Rotation and terrestrial magnetism. *See Abstr.* 5232

550.384 : 523.746

3. "Sudden commencements" in the Greenwich magnetic records (1879–1944) and related sunspot data. WTON, H. W. *Mon. Not. Roy. Astr. Soc. Geophys. Ppl.*, **5**, 159–85 (*Jan.*, 1948).—An examination of eenwich magnetograms covering 6 sunspot cycles eals 681 sudden commencements (SCs). About f these have a small preliminary impulse in opposi- n to the main impulse and lasting $\sim \frac{1}{2}$ min. The rrence and magnitude of the preliminary impulse pear to be subject to diurnal fluctuations. SCs erally show a diurnal frequency variation with a imum at 8 hr and a broad afternoon maximum. ere is also a seasonal variation with a minimum in nter and a maximum in summer, which contrasts ongly with the seasonal variation of disturbances preceded by SCs. 11-year frequency graphs of s agree well with sunspot curves, but differ rkedly from those of disturbances with no SC et. There is a tendency for SCs preceding storms occur when big spots are about one day past the tral meridian. A. T. P.

550.384.4

4. Daily magnetic variations near the equators. ARTYN, D. F. Letter in *Nature, Lond.*, 685–6 *pril* 30, 1949).—The increase in amplitude of the ly magnetic variations in equatorial regions is own to be approximately symmetrical about an ator which is midway between the magnetic and magnetic dipole equators. It is inferred that there probably a region of high electric conductivity out 15° of latitude wide encircling the world dway between these equators. A. T. P.

550.837 : 627.8

5. The application of geoelectric methods in the nning of storage walls and storage dams. FRITSCH, *Öst. Z. Elektrizitätswirtsch.* [*ÖZE*] **2**, 136–41 *une*, 1949) *In German.*—Geoelectric methods, ing to their cheapness and adaptability, are idually replacing other methods in the investiga- n of the soil at dam sites. Data may be obtained the porosity of the soil, the presence of clefts and layers of loam, clay, dry or watersoaked sand. e fundamentals of the method are discussed; mulae, graphs and tables are given showing the ecific resistance values of various kinds of rocks and er constituents of the soil. The simplest method, four-point method, consists in applying a potential ference between two fixed points of the surface d measuring the potential difference between two ermediate points by movable sounding electrodes, the same time measuring the current between the ed electrodes. Measurement is made either with . or with l.f. or h.f. a.c. R. N.

550.839

6. Gamma-ray well logging. FEARON, R. E. *ucleonics*, **4**, 67–75 (*April*, 1949).—An expression is rived for the γ-radiation intensity in a cylindrical vity in an infinite medium; this approximates the nditions in a bore-hole. With certain simplifying sumptions, it is shown that the ionization energy expended in the gas of an ionization chamber placed in the cavity is equal to the radiation energy emitted in the same time by an amount of rock having the same weight as the gas in the chamber. A bore hole can be surveyed at several 1 000 ft/hr; the alternation of radioactive shale and inactive limestone is shown in a specimen record. Various practical aspects of the problem are discussed. A. P. F.

551.48.018.9 : 535.341

5807. Photometric underwater investigations in the Caldonazzo (Trento, Italy) lake. POLLI, S. *Ann. Geofis.*, **2**, 40–8 (*Jan.*, 1949) *In Italian.*—The variation with depth of the absorption of different wavelengths was investigated with a photocell photometer. L. P.

ATMOSPHERE . METEOROLOGY 551.5

551.51

5808. Physics of the atmosphere. VASSY, A. *J. Phys. Radium* (*Sér.* 8) **10**, 1*d*–5*d* (*Feb.*, 1949) *In French.*—A review of recent investigations with a comprehensive bibliography. A. C. C.

551.510.4 : 523.77

5809. On the question of atmospheric ammonia. MIGEOTTE, M. V. AND CHAPMAN, R. M. Letter in *Phys. Rev.*, **75**, 1611 (*May* 15, 1949).—The supposed detection of atmospheric NH_3 by absorption in the 2 μ-region of the solar spectrum reported by Mohler [Abstr. 3603 (1949)] is not confirmed by observations in the region of an expected NH_3 band at $10{\cdot}5\ \mu$. M. W. O.

551.510.5 : 621.396.9

5810. Theory and practice of tropospheric sounding by radar. FRIEND, A. W. *Proc. Inst. Radio Engrs*, **37**, 116–38 (*Feb.*, 1949).—A theoretical analysis of the problem of tropospheric sounding by radar methods leads to the conclusion that comprehensive experimental data could be obtained from continuous operation with maximum power on frequencies near 400, 4 000 and 40 000 Mc/s. The first frequency should record major dielectric-variation phenomena, the second dielectric fine structural effects and the structure of dense precipitation regions whilst the highest frequency could be used for the detection of the smallest concentrations of minute precipitate or dust particles. W. J. G. B. (R)

551.510.535

5811. The influence of vertical ionic drift on a "Chapman region." KIRKPATRICK, C. B. *Aust. J. Sci. Res. A*, **1**, 423–42 (*Dec.*, 1948).—Vertical transport of ions is taken into account in a theoretical treatment of an ionized region in which ion production and decay are operative. Methods are evolved for computing the electron density in both a "moving" and a static layer. Ionic drift is believed to be caused by tidal motion of the upper air and so, for conditions representative of the E region and the solar atmospheric tide, the effect of ionic drift is investigated and the theoretical departure from normal "Chapman" behaviour is measured. A.

551.510.535

5812. Ionospheric effects of solar flares 1948. RYDBECK, O. E. H. AND STRANZ, D. *Trans. Chalmers Univ. Tech., Gothenburg* (*No.* 83) 1–16 (1949) *In English.*—Regular recordings of ionospheric effects of solar flares with different kinds of apparatus were started at the Geophysical Observatory, Gothenburg, early in 1948. The results of the first half year are presented and analysed in this preliminary communication. The statistical distribution of radiation sources of stronger and weaker fade-outs across the solar disc is shown. The magnitude and probability of the absorption of the ultraviolet fade-out radiation in the solar corpuscular beam is discussed. A.

551.510.535

5813. Maintenance of nocturnal ionization. GERSON, N. C. Letter in *Nature, Lond.*, **163,** 491 (*March* 26, 1949). *Erratum, ibid.*, **163,** 760 (*May* 14, 1949).—Subject to assumptions about the diurnal variation in temp. at the level of the F_2 layer (including an exponential decrease of temp. at night), an expression is obtained for the nocturnal variation in ionization density. The observed values are stated to be in much better agreement with this expression than with that deduced from a simple recombination law. W. J. G. B.

551.510.535 : 621.396.11

5814. Pre-[sunrise] ionization in the daily formed layers of the ionosphere. THEISSEN, E. *Naturwiss.*, **34** (*No.* 12) 371–2 (1947) *In German.*—Normal incidence ionospheric observations at sunrise during the midsummer period of 1947 indicate that, on the average, the ionization in the normal *E* layer begins to increase some 80 min before ground sunrise and initially rises linearly at a rate corresponding to 0·6 Mc/s/hr. The rate of increase of critical frequency after sunrise is smaller than that expected from the $(\cos\chi)^{\frac{1}{2}}$ law. (χ = solar zenith angle). W. J. G. B. (R)

551.513

5815. Translation and development in two-dimensional fields, with special reference to pressure variations. JAMES, R. W. *Aust. J. Sci. Res. A,* **1,** 412–22 (*Dec.*, 1948).—In previous studies of translation of field entities attention has been focused on singular points and lines of the field, with the result that the complementary concept of development in the field has been left either not at all, or quite arbitrarily, defined. By determining the least-squares fit to the rate of change of the entity throughout the field, rigid and unique definitions are derived of both the translation and rotation of the system of isolines of the entity, and also of the local and total development in the field. The practical result is to derive a system of weighting factors for the translation of elements of the field, and to stress the special importance of those regions where the gradient of the entity is greatest. In meteorology this means that the movement of pressure-systems is dominated by that of the regions of strongest wind. Comparison is made with earlier results, and the question of the consistent motion of co-existent fields (e.g. pressure and temp.) is discussed. A.

551.513 : 523.4

5816. The instability of wind discontinuities and shear zones in planetary atmospheres. HAURWITZ, B. *J. Met.*, **6,** 200–6 (*June*, 1949).—It is shown t perturbations forming at wind discontinuities in atmospheres of rotating planets are unstable, e though the distribution of the angular momentum the rotating planet exerts a stabilizing influe Consequently disturbances can develop spontaneou Presumably at least some of the markings obser on planets, especially on Jupiter, represent s disturbances. The velocity of these perturbation found not to differ greatly from the mean velo of the fluid on both sides of the boundary. Therefo the determination of planetary velocities of rotat from visual observations of such surface marki appears justified.

551.51

5817. Some computations of the atmospheric t bulence. JOHANNESSEN, T. W. *Met. Ann.*, **3** (*No.* 15–58 (1949) *In English.*—Wind records are classif into five groups of short or long period with stable unstable temperature lapse rates and the types of t bulence considered are frictional, convectional a large scale. Numerical values are obtained for the to eddy stress, the stress for large-scale turbulence, and frictional effect, by using hodographs of the vert wind distribution at Hanover for different types air mass and for summer and winter. Eddy co vectivity in air currents smoothed over a long per is obtained in different types of air mass, and fin the semilateral eddy conductivity due to large-scale frictional turbulence is calculated for success heights in the different air masses. Since the physi nature of large-scale turbulence is only imperfec known, and the equations for frictional turbule are derived from those for large-scale turbuler further progress must depend upon examination of physical nature of large-scale turbulence. R. S

551.577 : 621.39

5818. Radar observation of heavy rain. JONES, R Letter in *Nature, Lond.*, **163,** 728–9 (*May* 7, 1949) A summary of experiments carried out near Dunsta on a station equipped with $\lambda = 10$ cm, 2 μsec-pu radar equipment. Meteorological stations in neighbourhood are equipped for measuring rain rate and drop-size whilst the phenomena can related to the general meteorological situation determined by *radio sonde* ascents through Britain. The object was to investigate the physi processes in clouds, in particular the relation of echoes to vertical currents and to icing which mi constitute dangers to aircraft. Photographs illustr the echo situation on the range-height and p displays. A. C

551.593

5819. The intensity of twilight and its connect with the density of the atmosphere. LJUNGHALL, *Medd. Lunds. Astr. Obs.* (*Ser. II*) (*No.* 125) 7– (1948) *In English.*—Visual and photoelectric meth have been used to measure twilight intensity (o magnitude scale) at 4 stations (1946–48) for s depressions, 0° sun 12°, at different altitudes on vertical. Calibration was effected by reference to brightness of the full moon (reduced to outside atmosphere). Observations were made of (*a*) i grated scattered light; (*b*) light transmitted by b

en and red filters respectively. Results are com-
ed with those of other investigators, and they
vide also a basis for the evaluation of the density
the atmosphere over a range of height from 40 km
150 km on the assumption of Rayleigh scattering.
appendix includes detailed observational data,
l an extensive bibliography. D. R. B.

551.594.11

**20. The double periodic daily change of the atmo-
eric electric potential gradient as a consequence of
ıstausch] exchange.** FRANKE, M. *Geofis. Pura.
l.*, **14**, 120–31 (*Jan.–March*, 1949) *In German.*—
e is made of Brown's view that the local variation of
earth's electric field at land stations is mainly caused
the cycle of turbulence, convection and subsidence.
ing temperature observations at Leafield on clear
/s, computed values of the daily variation of the
ıstausch" coefficient, an exact measure of atmo-
eric turbulence, were used to obtain the daily
iation of nuclei and thence the variation of ions,
nductivity and local potential gradient. When this computed variation of potential gradient is combined with the unitary variation of the earth's field over the oceans, a double period (local time) of the potential gradient of the earth's electric field is obtained for land stations. Thus this double period has been reduced to a single period which cannot be explained by "austausch." R. S. R.

551.594.5 : 523.87

5821. The excitation of forbidden lines by electron impacts—nebulae, novae, polar aurorae. BARBIER, D. *Ann. Astrophys.*, **2**, 193–217 (*July–Sept.*, 1948) *In French.*—On the assumption that the "forbidden" lines in the spectra of nebulae, novae and aurorae are emitted by impact of electrons liberated by primary ionizing particles of high energy, excitation probabilities, electron temps. and electronic densities are computed for each case. It is found that, for aurora polaris, temps. $\sim 28\,000°$K, and densities from 10^{12}–10^{8} electrons/cm^3 over the height range, 80–300 km result. Calculations for the highest level agree with direct radar observations. D. R. B.

BIOLOGY 57/59

578

**22. A cardiotachometer based on the plethysmo-
ım.** SUCKLING, E. E. *Rev. Sci. Instrum.*, **20**,
3–19 (*July*, 1949).—An instrument is described
ich enables the pulse rate in humans to be con-
uously observed. The pulsations generated in a
rtially inflated blood pressure measuring cuff are
nverted into electrical pulses and applied to a
unting rate circuit. A.

578

**23. Syringe oxygen cathode for measurement of
ygen tension in solution and in respiratory gases.**
BIAS, J. M. AND RETONDO, N. *Rev. Sci. Instrum.*,
519–23 (*July*, 1949).—A method is described for
asuring O tension in Ringer solution which utilizes
principle of the polarograph, but substitutes a Pt
e cathode for the usual dropping Hg electrode.
e wire cathode and a calomel anode are mounted
the piston of a hypodermic syringe into which the
ution is aspirated for analysis. Sensitivity and
producibility are evaluated. Extension of the
thod to the analysis of gaseous O is also described.
A.

578 : 534.321.9

Biological effects of ultrasonic waves. *See Abstr.*
14

578 : 539.167.3

**24. Use of Geiger counter for quantitative estima-
n of radioactive isotopes in histological sections.**
URNE, G. H. *Nature, Lond.*, **163**, 923 (*June* 11,
49).—Tissues are cut and mounted on glass slides
th cellophane cover slips. The microscope stage
s a 0·5 mm Cu sheet pierced by a 0·5 or 1 mm hole,
ldered to its under-surface. A slide placed on the
ovable part of the stage could then be "scanned" by
e hole. The Geiger–Muller tube is enclosed in a Pb
stle designed to take this movable stage and slide.
s example of the technique, counts are given, from different follicles of thyroid tissue, from a rat previously injected with 24 microcuries of I^{131}. T. A. C.

578 : 539.167.3

5825. Use of radioactive tracers in biological research. PANETH, F. A. *Nature, Lond.*, **163**, 388–90 (*March* 12, 1949).—Introduction of tracer technique has been likened to the invention of the microscope. Reference is made to the use of radio-nuclides in the study of photosynthesis, permeability of cell membranes, life-time of red blood cells and the metabolism of P, Ca and I. A biological tracer experiment with C^{14} half life $\sim 5\,000$ yr occurs in nature. Produced in atmosphere by the action of neutrons from cosmic rays on N, it is assimilated by plants and gets into the bodies of animals and men; but its life-time is limited. In coal and oil deposits of geological age the activity has vanished. CH_4 from oil fields is inactive, but CH_4 from a sewage disposal plant contains the standard amount of C^{14}. Any C participating in a life cycle is thus labelled. T. A. C.

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.2 : 533.6.011

5826. Modified string flowmeter for measuring breath velocity. SPECHT, H. AND BRUBACH, H. F. *Rev. Sci. Instrum.*, **20**, 442–6 (*June*, 1949).—An instrument is described which measures instantaneous breath velocities without incurring high flow resistances. It records reciprocating flows, such as those of the full breath cycle, within the limits of normal breath velocities with high frequency resolution and yields accurate and reproducible measurements when suitably calibrated. The system described incorporates an automatic control over a valve system insuring

directed flow of the respired gases through a closed breathing circuit, permitting measurement of breath velocities at simulated high altitudes. The advantages, disadvantages, and idiosyncrasies of this type of instrument as used in physiological measurement are discussed. A.

612.84

5827. Absorption spectra, molecular weights, and visual purple. WEALE, R. Letter in *Nature, Lond.*, **163**, 916–17 (*June* 11, 1949).—It is assumed that one electron per molecule is responsible for the mechanism of absorption of light. The molecular weight M of reduced haemoglobin is calculated from a classical dispersion formula, and found to be 69 500. This agrees with the accepted value of 68 000. The treatment is extended to the absorption-band of visual purple: $M = 45\,600$, which is compared with Hecht and Pickels' value [Abstr. 2486 (1938)] of 270 000, obtained by the use of the ultracentrifuge. It follows from the new value of M that there are 2 chromophores per molecule of visual purple instead of 10, as yielded by the other value. R. A. W.

612.84

5828. Small voluntary flicking and following eye movements. LORD, M. P. AND WRIGHT, W. D. Letter in *Nature, Lond.*, **163**, 803–4 (*May* 21, 1949).—Previous apparatus [Abstr. 806 (1949)] is modified for the recording of larger eye-movements at a reduced sensitivity. The movements studied are due to conscious shifts of fixation points, and fixation of points oscillating vertically and horizontally through 1–4°. Records are shown for fast and slow flicks in the operator's and observer's times respectively. An upper limit of 2 flicks/sec was observed when the rate of flicking was changed from medium to fast; there was little corresponding increase in the rate of transfer from one point to another. Slow flicks produced a discontinuous, though subjectively smooth, movement. For horizontal and vertical separations, the movement may be in more than one direction. Values are given for the distance between the centre of curvature of the cornea and the pivot of the eye, and shown to differ under various conditions. R. A. W.

612.843.31

5829. New experiments in colour vision. GEHRCKE, E. *Ann. Phys., Lpz.* [*Folge* 6] **2** (*Nos* 7–8) 345–54 (1948) *In German.*—Rotating discs with various black and white patterns evoke red, green, blue, yellow, black and white sensations when illuminated with a Na lamp only. The reactions of colour-blind subjects to these after-images suggest that their deficiencies lie in the conducting rather than the receptor organism. Colour sensations must be dissociated from the receptors found in the retina, which provide only one of six ways of causing the sensation of colour. It is concluded that there is a special organ outside the retina, which is responsible for the sensation of colour. Its location is uncertain, possibly in the primary visual areas. R. A. W.

612.863.6

5830. The radiation pattern of retinal receptors. TORALDO DI FRANCIA, G. Letter in *Proc. Phys. Soc. Lond. B*, **62**, 461–2 (*July*, 1949).—The directional sensitivity of the retina is ascribed to the cones behaving like micro-antennae [Abstr. 2262 (194… Stiles and Flamant's results [*J. Physiol.*, **107**, … (1948)] are used for the derivation of the polar ra… tion pattern of the cones for $\lambda = 7\,000$ Å: a princ… lobe and parts of the first side lobes are shown, … compared with the pattern due to a dielectric ante… radiating from one of its ends. R. A.

614.8 : 535.3 : 537.…

Attenuation of 500–1 400 kV X-rays in lead concrete. *See Abstr.* 5454

614.8 : 539.…

5831. Gamma-ray shielding data. *Nucleonics*, … 44–5 (*Oct.*, 1948).—Tables are given from wh… the thickness of shielding (H_2O, Al, concr… Fe or Pb) required to reduce the daily dosage… 0·1 r may be found for source strengths fr… 10 mc to 100 c, for γ-ray energies from 0·2… 6·0 MeV, for source distances from 20 cm to 10… and for daily exposures of 1 hr to 24 hr. A. P.

614.8 : 539.…

5832. Waste disposal symposium. *Nucleonics*, … 9–23 (*March*, 1949).—A very general discuss… dealing with the sources and types of radiati… tolerance doses for different organisms (including … to selective absorption by certain organs), … techniques of dealing with radioisotopes and … waste products. Methods of handling solid, liq… and gaseous waste materials are separately outlin… The possibility of using micro-organisms to abs… and concentrate active material is favoura… mentioned. A. P.

614.8 : 539.…

5833. Stack meteorology and atmospheric dispo… of radioactive waste. BEERS, N. R. *Nucleonics*, … 28–38 (*April*, 1949).—After air has been used … cooling a pile, the A^{41} produced in it may form… radiation hazard unless properly dispersed. T… avoidance of dangerous concentrations at grou… level is secured by ejecting the coolant at a height… several 100 ft after diluting it with normal air. T… hazard is most acute under lapse conditions (cold … above warm), when 3-dimensional eddies may ca… gases to the ground with very little dilution. T… system for studying dispersion at Brookhaven … described: oil-fog from a smoke generator is c… charged into the atmosphere at 350 ft, and lo… concentrations of the fog are measured with a pho… metric densitometer (depending on small-an… scattering of light); results are checked by measur… amounts of oil collected on filter-paper in an … sampler. Routine records of temp. gradient and wi… velocity are also made. A. P.

614.8 : 539.…

5834. The fast neutron hazard. EVANS, T. *Nucleonics*, **4**, 2–8 (*March*, 1949).—The effects … 4 MeV neutrons and 185 keV X-rays on mice w… studied for many different intensities of irradiati… from single large doses to multiple small daily dos… Data were collected on survival times, blood coun… and damage to tissues and organs. The neutron/X-… ratio measured in terms of physiological effe… appeared to grow, for given values of total physi… dosage, as the dose-rates were reduced. Neutr… exposures equivalent, in terms of survival time, t… given X-ray dosage were found to be much m…

ngerous in their specific effects on the testes and lens of the eye. A. P. F.

614.898

5835. Medical X-ray protection up to two million ts. *Handb. U.S. Bur. Stand.* (*No.* 41) 1–43 (*March*, 49).—Detailed recommendations for design of lding and personnel monitoring for the various egories of diagnostic and therapy equipment. uctural methods to prevent scatter at joints, etc., l thicknesses of lead for primary and secondary liation to comply with a tolerance dose of 0·3 r/week given. Screens 1·5 mm Pb should be used for all gnostic plant, and a tube filter of at least 1·5 mm Curves are given of attenuation in Pb up to MeV and in concrete up to 2 MeV, as well as of safe rking distances; the recommendations throughout slightly more stringent than those put forward in corresponding British (N.P.L.) report. F. T. F.

615.84

5836. Dielectric properties of the human body in the crowave region of the spectrum. ENGLAND, T. S. D SHARPLES, N. A. Letter in *Nature, Lond.*, **163**, 7–8 (*March* 26, 1949).—Using surgical specimens in a waveguide cell, measurements of attenuation and phase constant on a number of body tissues, including carcinomatous, at a wavelength of 3·18 cm are described. The results are compared with H_2O and the variations, except for bone and fatty tissue, are small. For a wave incident on the body about ¼ of the energy is absorbed and penetration is to a depth of a few mm. F. T. F.

616–07

5837. Localization of brain tumours with radiodyes. I. BOYACK, G., MOORE, G. E. AND CLAUSEN, D. F. *Nucleonics*, **3** (*No.* 4) 62–8 (*Oct.*, 1948).—A method for the preparation of di-iodo^{131}-fluorescein, which collects preferentially in tumours, is given. Experiments are described by which the power of detecting and locating tumours was studied. A tumour of 20–40 cm^3 volume can be detected if it retains a radiodye concentration > twice that of the surrounding tissue. (For actual tumours, concentration ratios from 2 : 1 to 17 : 1 have been observed.) A Geiger counter in a cylindrical Pb shield, with its axis always directed normally towards the skull, appears to give adequate location. A. P. F.

GLASS . CERAMICS 666

666

5838. The influence of heavy metal ions on the groscopicity of a glass surface. ROMAN, M. K., ARBOE, E. C. AND WEYL, W. A. *J. Soc. Glass Tech.*, 260–3 (*Oct.*, 1948).—Describes measurements of surface hygroscopicity of glasses after treatment h aqueous solutions of metal salts. Large ions the inert gas type (Ba^{2+}) or having 18 outer ctrons (Zn^{2+}, Cd^{2+}) and especially non-noble-like ions (Pb^{2+}) decreased hygroscopicity appreably. Results are explained by polarizability and refore asymmetric behaviour of these ions. See o following Abstr. G. O. J.

666

5839. The surface properties of glasses as affected heavy metal ions. WEYL, W. A. *J. Soc. Glass h.*, **32**, 247–59 (*Oct.*, 1948).—Explains the influence the presence of heavy metal ions such as Ba^{2+} and $^{2+}$ on the surface properties of glasses, especially the surface tension, adhesion to noble metals, face reactivity and hygroscopicity, frictional and ctrical surface behaviour. These ions differ from ble-gas-like ions such as Sr^{2+} in being large (Ba^{2+}) in having 2 outer electrons (Pb^{2+}). They are hly polarizable and asymmetric in their chemical haviour, and in the surface orient themselves so t cohesive forces are directed towards the interior l the surface free energy and reactivity are reduced. perimental methods are suggested for further estigation. G. O. J.

666

5840. Viscosity-composition-temperature relations in system Na_2O–SiO_2. BARBER, S. W. Letter in *J. Chem. Phys.*, **16**, 1167 (*Dec.*, 1948).—Discusses viscosity data in the soda-silica series on the assumptions that the binding is ionic above about 1 600°K, but ionic-covalent at lower temps., and that the viscosity is determined by the mobility of the sodium ions. G. O. J.

666.1

5841. How the chemical composition is selected for a glass required to show particular physical properties. DANZIN, A. *Ann. Radioélectricité*, **3**, 153–68 (*July*, 1948) *In French.*—A survey of the chemical compositions of glasses as used for particular purposes, and of the relevant empirical property-composition relationships. 4 tables and 6 figures. G. O. J.

METALLURGY 669

669

5842. The system silver–magnesium–tin, with reference to the theory of ternary alloys. RAYNOR, G. V. AND FROST, B. R. T. With an Appendix on **The structure of the β′ superlattice.** HALL, W. H. *J. Inst. Met.*, **16**, 777–808 (*June*, 1949).

669 : 539.185

5843. Effect of neutron bombardment on order in the alloy Cu_3Au. SIEGEL, S. *Phys. Rev.*, **75**, 1823–4 (*June* 15, 1949).—Samples of the alloy Cu_3Au in the ordered and disordered states have been exposed in a nuclear reactor, subject to an integrated fast neutron flux up to $3{\cdot}3\times10^{-19}$ neutron/cm^2. The electrical resistivity, and presumably the disorder, in the initially ordered sample increases, while little change is observed in the initially disordered samples. A.

PHOTOGRAPHY 77

77.023.4

5844. Electron microscopic investigations of developed photographic layers. KÜSTER, A. *Z. Wiss. Photgr.*, **43** (*Nos* 9–10) 191–200 (1948) *In German.*—Electronmicrographs taken from normally developed AgBr grains (having diameters from 0·025–1·6 μ) show the formation of filaments of Ag protruding from the crystals. Physical development after fixation leads to compact round Ag grains, whereas physical development before fixation leads to relatively long bands of Ag. The relation between the size of the AgBr grains and the shape of the developed grains has been studied as a function of the concentration of the developer. An interpretation is given for the different formation of Ag images, as obtained by the electron microscope. R. H. H.

77.023.4

5845. The Herschel effect and the structure and stability of the photographic latent image. KORNFELD, G. *J. Opt. Soc. Amer.*, **39,** 490–4 (*June*, 1949).

771.534

5846. Some remarks on gold treatment of photographic silver halide emulsions. MUELLER, F. W. H. *J. Opt. Soc. Amer.*, **39,** 494–6 (*June*, 1949).—Earlier attempts of various investigators to increase the sensitivity of photographic emulsions by addition of colloidal Ag, AgS or Au are reviewed. Koslowsky's discovery of the effect of certain Au complex salts as powerful sensitizers is described and a possible mechanism of the effect discussed. The importance of this effect for the manufacture of modern high speed and fine grain film as well as special X-ray emulsions is indicated. A.

778.3

5847. Photomicrography of tracks in nuclear research emulsions. MORRISON, A. AND MORTON, F. *Rev. Sci. Instrum.*, **20,** 341–2 (*May*, 1949).—A simple projection system and film holder for taking photomicrographs of particle tracks in photograph emulsions of the type used for nuclear research described. With this film holder a series of exposur covering a considerable length of the track image obtained on a single film as adjacent segments track are brought successively into sharp focus a recorded.

778.3 : 539.

5848. The photographic emulsion in nuclear physi MEYER, P. *Naturwiss.*, **35** (*No.* 12) 369–74 (194 *In German.*—The recent development of the meth of recording charged particle tracks in phot graphic emulsions is described and many illustratio of nuclear and cosmic-ray processes chiefly taken fr the Bristol school are shown. A comprehensive l of references dating from 1910 to 1948 is appended. R. H.

778.

5849. Sensitivity and exposure graphs for radiu radiography. JOHNS, H. E. AND GARRETT, *Canad. J. Res. A*, **26,** 292–305 (*Sept.*, 1948).—T slotted wedge penetrameter used in X-ray techniq has been utilized for γ-ray industrial radiograph It is customary to use a front screen of Pb and thicker back screen, to give an intensification effe For max. density for a given casting thickness th is an optimum thickness of the front screen. Measu ments are described in detail, made to determine t optimum thickness of the front screen in relation casting thickness. The sensitivity was also inves gated in respect to variations with films of varyi manufacture used for the tests. The sensitivities o commercial films are tabulated in relation to t front Pb screen thickness and exposures. It considered that where the thicknesses of castin vary greatly, penetrameter sensitivity curves shou be produced and utilized, in preference to grap relating photographic density to exposure factors. B. J.